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Original Article

PHYTOCHEMICAL SCREENING AND *IN VITRO* ANTIBACTERIAL ASSESSMENT OF DIFFERENT *INDIGOFERA ARRECTA* SOLVENT EXTRACTS AGAINST SELECTED PATHOGENIC MICROORGANISMS

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ABSTRACT

Objective: The current study was done to analyze qualitatively the presence of pharmacological compounds and the antibacterial activity of different extracts of *Indigo feraarrecta.*

Methods: The plant was extracted using hydromethanolic solvent. The extracted compounds were dissolved in different solvents according to their polarity and then concentrated using a rotar vapor with a water bath at 40^{o}C. The antibacterial assessment was done using well diffusion method and the phytochemicals analysed using standard procedures with minor adjustments.

Results: The study demonstrated thatthe plant contains very important pharmacological compounds. The extracts tested had different inhibitions on the microorganisms tested. Ethyl acetate extract inhibited the growth of all the selected pathogenic organisms while the water extract inhibited the growth of three out of the five microorganisms tested. Hexane and butanol inhibited only *Bacillus cereus* out of the five microorganisms used in the study. The penicillin which was used as the positive control inhibited the growth of all the organisms, while dimethylsulfoxide(DMSO) did not inhibit the growth of any of the organisms.. One-way analysis of variance (ANOVA) showed there was significant difference in the microorganisms zones of inhibition ($P<0.05$).

Conclusion: The results obtained in this research are a scientific justification of the plant's use in the treatment of various diseases. The results have revealed thatthe plant has great potency in the treatment against infections caused by all the bacteria tested. However, further research needs to be done to isolate the active compounds, identify their structural formula, their mode of action and their effect in the in vivo environment.

Keywords: Phytochemical, Antibacterial, Plants, *Indigo feraarrecta*, Medicine.

INTRODUCTION

The use of plants as a source of medicine is as old as man himself. Plants have been used since time immemorial to treat against various diseases affecting human beings all over the world. Before the invention of synthetic drugs traditional medicine dominated the world. Studies by WHO have shown that a large number of individuals are using medicinal plants for treatment even today. The results obtained shows that the number is also increasing among the young people all over the world [1]. It is estimated that 80% of the population in developing world use traditional medicines which mainly consists of plants for their basic health care [2]. This could be attributed to poverty in these countries which makes many people unable to access modern hospitals and purchase aliphatic drugs for treatment. It is due to this reason that many people turn to plants which are believed to be non-toxic, readily available and affordable to the local population [3].

The continued emergence of drug resistant microorganisms has always been a concern to scientists and pharmaceutical companies. Drug resistant microorganisms have also been an economic concern with impacts of them being felt by pharmaceutical companies, patients, medical practioners and the public [4]; however plants have provided an alternative by providing a source of active compounds which have been used as drugs. The invention of active antibiotic compounds from plants has increased the interest on the study of plants as a source of new antibiotics [5&6].

The genus Indigofera contains 700 species of plants which belong to the family Fabaceae. The plants in this genus are mainly found in the tropical and sub-tropical regions all over the world [2]. Various species of the genus Indigofera are used for the production of the dye indigo, treatment against epilepsy, liver disease, bronchitis, psychiatric illness, anticancer therapy and anti- inflammatory activity [7-9].

The plants of this genus also have antitumor activity [10]. The plant *Indigoferaarrecta* is used to relieve ulcer pain. The plant is used traditionally to treat against stomach problems in many communities in Kenya such as the Kamba and the Nandi communities. The current study was done to determine the antibacterial activity of different extracts of *Indigo feraarrecta* leaves and the phytochemicals present in the plant.

MATERIALS AND METHODOLOGY

Sample Collection and Preparation:

The herb was randomly collected in the natural forest around University of Eastern Africa, Baraton. The plant samples were identified by a taxonomist in the University of Eastern Africa, Baraton. They were then thoroughly mixed and spread to dry at room temperature in the chemistry laboratory for about three weeks and ground into fine powder. The samples were stored intransparent polythene bags.

Extraction procedure

Using electric analytical beam balance 100 grams of the powdered samples were placed in 500 ml* conical flask, methanol and water were then added in the ratio of 9:1 respectively until the samples were completely submerged in the solvent. The mixture was then agitated for thorough mixing and kept for 24 hours with frequent shaking for effective extraction of the plant components. The extract was filtered using Butchner funnel; Whatman no.1 filter paper and a vacuum and pressure pump. The filtrate was re-filtered again using the same apparatus. The solvent was evaporated using rotary vacuum evaporator (R-11) with a water bath at 40^{o}C. The crude extract was then fractionated into different solvents in order to separate the compounds according to polarity using chloroform, ethyl acetate, water and then butanol. The fractions where then concentrated and the residues obtained stored at 4^{o}C for the study.

Qualitative phytochemical analysis

The extracts phytochemical analysis for identification of bioactive chemical constituents was done using standard procedures with minor adjustments [11-13].

Tannins

About 0.5 g of the sample was put in a test tube and 20 ml of distilled water was added and brought to boil. The mixture was then filtered and 0.1 % of $FeCl_3$ was added to the filtrate and observations made. A brownish green color or a blue-black coloration indicated the presence of tannins.

Saponins

The crude solvent extract was mixed with 5 ml of water and vigorously shaken. The formation of stable form indicated the presence of saponins.

Flavonoids

A portion of the extract solution was added in to a test tube. To the test tube 5 ml* of dilute ammonia and 2 ml* of concentrated sulphuric acid was added and heated for about 2 minutes. The appearance of a yellow color indicated the presence of flavonoids.

Terpenoids

The solvent extracts of the plant material was taken in a clean test tube, 2 ml of chloroform was added and vigorously shaken, then evaporated to dryness. To this, 2 ml of concentrated sulphuric acid was added and heated for about 2 minutes. A greyish color indicated the presence of terpenoids.

Glycosides

Salkowsks' test

The solvent extract of the plant material was mixed with 2 ml of chloroform and 2 ml of concentrated sulphuric acid was carefully added and shaken gently, then observations were made. A red brown color indicated the presence of steroidal ring (glycone portion of glycoside).

Alkaloids

The crude extract was mixed with 1% of HCl in a test tube. The mixture was then heated gently and filtered. To the filtrate a few drops of Mayers and Wagner's reagents were added by the side of the test tube. A resulting precipitate confirmed the presence of alkaloids

Steroids

Libermann-Burchard reaction

About 2g of the solvent extract was put in a test tube and 10 ml of chloroform added and filtered. Then 2 ml of the filtrate was mixed with 2 ml of a mixture of acetic acid and concentrated sulphuric acid. Bluish green ring indicated the presence of steroids.

Phenols

The plants solvent extract was put in a test tube and treated with a few drops of 2% of $FeCl_3$; blue green or black coloration indicated the presence of phenols.

Bioassay study

Preparation of the Bacterial Suspension

The turbidity of each of the bacterial suspension was prepared to match to a 0.5 McFarland standard, a procedure similar to that used by Biruhalem [14] and Donay et al., [15]. The McFarland standard was prepared by dissolving 0.5 g of $BaCl_2$ in 50 ml of water to obtain a 1% solution of Barium chloride (w/v). This was mixed with 99.5 ml of 1% sulphuric acid solution. Three – five identical colonies of each bacterium was taken from a blood agar plate (Himedia) culture and dropped in Mueller Hinton broth (Himedia). The broth culture was incubated at 37^0C for 2 - 6 hours until it achieved turbidity similar to the 0.5 McFarland standard. The culture that exceeded the 0.5 McFarland standard were each adjusted with the aid of a UV spectrophotometer to $0.132A^0$ at a wavelength of 600 nm in order to obtain an approximate cell density of $1x10^8$ CFU/ml.

Preparation of the Extract Concentrations and Antibiotic

Extracts stoke solutions were prepared by dissolving 500 mg in 1 ml of dimethylsulfoxide (DMSO). An antibiotic control was made by dissolving 500 mg of penicillin in 1 ml of sterile distilled water. DMSO served as a negative control.

Determination of the bioactivity of the Extract

Mueller Hinton agar plates were prepared by the manufacturer's instructions. The bacterial suspension was smeared on the media and five wells were drilled in each agar plate. Three of the wells were filled with the extract dilution and the other wells were filled with penicillin and DMSO control respectively. Three plates were made for each bacterial organism and extract giving a triplicate reading for each microorganism and extract. The plates were labeled on the underside and incubated at 37^0C for between 24 to 48 hours and the zones of inhibition measured in millimeters with the aid of a ruler.

RESULTS AND DISCUSSION

Bioassay results

From the Phytochemical analysis the aqua extract was found to contain tannins, Saponins, Terpenoids, glycosides, alkaloids and phenols but flavonoids and steroids were found to be absent. The hexane extract was found to contain tannins, Saponins, flavonoids, and steroids but terpenoids, glycosides, alkaloids and phenols. The butanol extract was found to contain tannins, saponins, flavonoids, glycosides, alkaloids, steroids and phenols but terpenoids were found to be absent. The ethyl acetate extract was found to contain tannins, Saponins, glycosides, alkaloids and steroids. The extract was found not to contain flavonoids, terpenoids and phenols.

The presence of these compounds in the plant gives it an edge in the treatment of various diseases. The presence of tannins in this plant may enable it to have astringent property which makes ituseful in preventing diarrhea and controlling hemorrhage due to the ability of tannins to precipitate proteins, mucus and constrict blood vessels [16]. This is the reason why traditional healers use plants reach in tannins to treat wounds and burns since they are able to cause blood clotting. Some tannins have been reported to inhibit HIV replication selectively besides the use of diuretics [17]. T.h.is shows how traditionally used medicinal plants rich in tannins can be used to control this dangerous disease. Tannins have also shown antiparasitic effects [18]. The anticarcinogenic and antimutagenic potentials of tannins may be related to their antioxidative property which is important in protecting cellular oxidative damage including lipid peroxidation. The growth of many fungi, yeast, bacteria and viruses have been proven to be inhibited by tannins [19].

Terpenoids have shown great potency in the treatment against microorganisms. According to Andrew [20], terpenoids have been studied in the in vivo environment and found to inhibit the growth of various bacteria. They have also shown potency in the treatment against *Plasmodium falciparum* which is the causative agent of malaria [21]. Terpenoids have been found to inhibit the growth of fungi *Candida albicans*[22].

Flavonoids are known to contain specific compounds called antioxidants which protect human, animal and plant cells against the damaging effects of free radicals. Imbalance between free radicals and antioxidants leads to oxidative stress which has been associated with inflammation, autoimmune diseases, cataract, cancer, Parkinson's disease, aging and arteriosclerosis [23]. Alkaloids on the other hand have been found to have analgesic, antispasmodic activity, antihypertensive effects, anti-malarial activity, anticancer and anti-inflammatory activities [24-26]. T.h.e presence of these phytochemicals in this plant leaves and based on the data provided

in the literature about them gives the plant its great pharmacological value. The ethyl acetate fraction (Table 7) inhibited the growth of all the organisms used in the experiment. The highest zones of inhibition were observed on *Escherichia coli*followed by *Bacillus cereus*, *Proteus vulgaris*, *Serratiamarcescens*and *Salmonella typhi* had the least zone of inhibition .

The positive control inhibited the growth of all the microorganisms while the negative control did not show any zones of inhibition against the microorganisms. A one-way analysis of variance (ANOVA) showed that there was significant difference between the zones of inhibition caused by the plant extract against the microorganisms and those caused by the positive control. On a further analysis using Tukey's pair wise comparison test, it was found that the zones of inhibition of *Bacillus cereus*(Table 8) were significantly higher than those of *Proteus vulgaris,Salmonella typhi, Serratiamarcescens* but significantly lower than those of *Escherichia coli* ($p< 0.05$). The inhibition zones of *Proteus vulgaris* were significantly lower as compared to those of *Escherichia coli* ($p< 0.001$). However there was no significance difference between the zones of inhibition of *Proteus vulgaris* and those of *Salmonella typhi* and *Serratiamarcescens* ($p > 0.05$).

The inhibition zones of the plant ethyl acetate extract against *Salmonella typhi* were significantly lower than those of *Escherichia coli* but not significant as compared to those of *Serratiamarcescens* while *Escherichia coli*zones of inhibition were significantly higher as compared to *Serratiamarcescens.* The inhibition zones caused by the positive control were all significantly higher than those caused by the plant extract.

Table 1: Antimicrobial activity of *Indigoferaarrecta* hexane fraction against selected pathogenic microorganisms

Microorganisms	Extract mean ±S. E. (mm)	Penicillin mean ± S. E. (mm)	DMSO Mean ± S. E. (mm)
Bacillus cereus	13.33 ± 0.882	24.67±0.333	0.00±0.000
Proteus vulgaris	0.00±0.000	30.33±0.333	0.00±0.000
Salmonella typhi	0.00±0.000	29.33±0.333	0.00±0.000
Serratiamarcescens	0.00±0.000	28.33±0.881	0.00±0.000
Escherichia coli	0.00±0.000	20.33±0.333	0.00±0.000

Key: S. E. = Standard error

Table 2: Tukey's honestly significant difference among micro-organisms using 500mg/l of *Indigoferaarrecta chloroform fraction*

Comparison	P-value	Significance
*B. cereus*vs*P. vulgaris*	0.000	S
B. c.e.reus vs *S. typhi*	0.000	S
B. cereus vs *S. marcescens*	0.000	S
B. c.e.reus vs *E. c.o.li*	0.000	S
B. c.e.reus vs *B. c.e.reus* control	0.000	S
P. vulgaris vs *S. typhi*	1.000	NS
P. vulgaris vs *S. marcescens*	1.000	NS
P. vulgaris vs *E. c.o.li*	1.000	NS
P. vulgaris vs *P. vulgaris* control	0.000	S
S. typhi vs *S. marcescens*	1.000	NS
S. typhi vs *E. c.o.li*	1.000	NS
S. typhi vs *S. typhi* control	0.000	S
S. marcescens vs *E. c.o.li*	1.000	NS
S. marcescens vs*S. marcescens* control	0.000	S
*E. coli*vs. *E. coli* control	0.000	S

Key: S- significant, NS – not significant

Table 3: Antimicrobial activity of *Indigoferaarrecta*butanol fraction against selected pathogenic microorganisms

Microorganisms	Extract mean ±S. E. (mm)	Penicillin mean ± S. E. (mm)	DMSO Mean ± S. E. (mm)
Bacillus cereus	8.33 ± 0.333	22.00±0.577	0.00±0.000
Proteus vulgaris	0.00±0.000	17.67±1.201	0.00±0.000
Salmonella typhi	0.00±0.000	20.33±0.333	0.00±0.000
Serratiamarcescens	0.00±0.000	21.00±0.577	0.00±0.000
Escherichia coli	0.00±0.000	12.33±0.333	0.00±0.000

Key: S. E. = Standard error

The aqua fraction (Table 5) inhibited the growth of *Bacillus cereus*,, *Salmonella typhi* and *Escherichia coli.*. Penicillin which was used as the positive control inhibited the growth of all the organisms, while DMSO which was used as the negative control. The analysis of variance showed that there was significant difference in the zones of inhibition amongst the microorganisms. A multiple comparison with Tukey's test (Table 6) showed that the zones of inhibition of *Bacillus cereus* were significantly higher than those of all the other organisms ($p<0.05$). The zones of inhibition of *Proteus vulgaris* were significantly lower as compared to those of *Salmonella typhi* ($p<0.05$), but not significant from those *Serratiamarcescens* ($p>0.05$). The zones of inhibition of *Proteus vulgaris* were significantly lower than those of *Escherichia coli* ($p<0.001$), on the other hand the zones of inhibition of *Salmonella typhi* were significantly higher than those of *Serratiamarcescens* but significantly lower than those of *Escherichia coli*. The inhibition zones of *Escherichia coli* were however, significantly higher than those of *Serratiamarcescens.* The inhibition zones caused by penicillin used as the positive control were significantly higher than those caused by the plant extract. The hexane extract only inhibited the growth of *Bacillus cereus.* The penicillin which was used as the positive control inhibited the growth of all the organisms used in the study (Table 1). The negative control (DMSO) did not show any zones of inhibition. The one-way analysis of variance showed that

there was significant difference between the zones of inhibition amongst the microorganisms. T.h.e zones of inhibition of *Bacillus cereus* (Table 2) were significantly high than those of the other organisms ($p<0.001$), while those of *Proteus vulgaris* were not significantly different from those of *Salmonella typhi*,*Escherichia coli* and those of *Serratiamarcescens.*

The zones of inhibition of *Salmonella typhi* were not significantly different from those *Serratiamarcescens* and *Escherichia coli,* while those of *Serratiamarcescens* were not significantly different from those of *Escherichia coli* ($p>0.05$). The positive control significantly inhibited the growth of the microorganisms as compared to the plant extract.

Table 4: Tukey's honestly significant difference among micro-organisms using 500mg/l of *Indigoferaarrecta*butanol fraction

Comparison	P-value	Significance
*B. cereus*vs*P. vulgaris*	0.000	S
B. c.e.reus vs *S. typhi*	0.000	S
B. cereus vs *S. marcescens*	0.000	S
B. c.e.reus vs *E. c.o.li*	0.000	S
B. c.e.reus vs *B. c.e.reus* control	0.000	S
P. vulgaris vs *S. typhi*	1.000	NS
P. vulgaris vs *S. marcescens*	1.000	NS
P. vulgaris vs *E. c.o.li*	1.000	NS
P. vulgaris vs *P. vulgaris* control	0.000	S
S. typhi vs *S. marcescens*	1.000	NS
S. typhi vs *E. c.o.li*	1.000	NS
*S. t.y.phi*vs*S. typhi* control	0.000	S
S. marcescens vs *E. c.o.li*	1.000	S
S. m.a.rcescens vs *S. marcescens* control	0.000	S
*E. c.o.li*vs*E. coli* control	0.000	S

Key: S- significant, NS – not significant

Table 5: Antimicrobial activity of *Indigoferaarrecta* aqua fraction against selected pathogenic microorganisms

Microorganisms	Extract mean ±S. E. (mm)	Penicillin mean ± S. E. (mm)	DMSO Mean ± S. E. (mm)
Bacillus cereus	19.67± 0.882	26.00±0.577	0.00±0.000
Proteus vulgaris	0.00±0.000	22.00±0.577	0.00±0.000
Salmonella typhi	9.33±0.333	29.00±0.577	0.00±0.000
Serratiamarcescens	0.00±0.000	25.33±1.202	0.00±0.000
Escherichia coli	16.00±0.577	23.33± 0.577	0.00±0.000

Key: S. E. = Standard error

Table 6: Tukey's honestly significant difference among micro-organisms using 500mg/l of *Indigoferaarrecta*aqua fraction

Comparison	P-value	Significance
B. cereus vs*P. vulgaris*	0.000	S
*B. c.e.reus*vs *S. typhi*	0.000	S
*B. cereus*vs *S. marcescens*	0.000	S
*B. c.e.reus*vs*E. c.o.li*	0.012	S
*B. c.e.reus*vs *B. c.e.reus control*	0.000	S
*P. vulgaris*vs *S. typhi*	0.000	S
P. vulgaris vs *S. marcescens*	1.000	NS
*P. vulgaris*vs*E. c.o.li*	0.000	S
*P. vulgaris*vs *P. vulgaris control*	0.000	S
*S. typhi*vs *S. marcescens*	0.000	S
*S. typhi*vs*E. c.o.li*	0.000	S
*S. t.y.phi*vs*S. typhi control*	0.000	S
*S. marcescens*vs*E. c.o.li*	0.000	S
*S. marcescens*vs *S. marcescens control*	0.000	S
*E. c.o.li*vs *E. coli control*	0.000	S

Key: S= Significance, NS= No significance

Table 7: Antibacterial activity of Ethyl acetate fraction against selected pathogenic microorganisms

Microorganisms	Extract mean ±S. E. (mm)	Penicillin mean ± S. E. (mm)	DMSO Mean ± S. E. (mm)
Bacillus cereus	14.33±0.333	27.00±0.557	0.00±0.000
Proteus vulgaris	11.67±0.333	24.33±0.333	0.00±0.000
Salmonella typhi	11.00±0.000	27.67±0.882	0.00±0.000
Serratiamarcescens	11.33±0.667	29.67±0.333	0.00±0.000
Escherichia coli	19.67±0.333	18.67±0.333	0.00±0.000

Key: S. E. – Standard error

Table 8: Tukey's honestly significant difference among micro-organisms using 500mg/l of *Indigoferaarrecta* Ethyl acetate fraction

Comparison	P-value	Significance
B. cereus vs*P. vulgaris*	0.019	S
*B. c.e.reus*vs *S. typhi*	0.002	S
*B. cereus*vs *S. marcescens*	0.007	S
*B. c.e.reus*vs *E. c.o.li*	0.000	S
*B. c.e.reus*vs *B. c.e.reus control*	0.000	S
*P. vulgaris*vs *S. typhi*	0.989	NS
P. vulgaris vs *S. marcescens*	1.000	NS
*P. vulgaris*vs *E. c.o.li*	0.000	S
*P. vulgaris*vs *P. vulgaris control*	0.000	S
*S. typhi*vs *S. marcescens*	1.000	NS
*S. typhi*vs*E. c.o.li*	0.000	S
*S. t.y.phi*vs*S. typhi control*	0.000	S
*S. marcescens*vs *E. c.o.li*	0.000	S
*S. marcescens*vs *S. marcescens control*	0.000	S
E. c.o.li vs *E. coli control*	0.000	S

Key: S= Significance, NS= No significance

The plant leaves butanol extract (Table 3) was found to inhibit the growth of *Bacillus cereus,*however the fraction did inhibit all the other organisms the plant was tested against (Table 1). The penicillin which was used as the positive control inhibited the growth of all the organisms while DMSO which was used as the negative control did not inhibit the growth of any of the organisms used in this study. A multiple comparison of significance between the zones of inhibition of the microorganisms showed there was significance difference between the zones of inhibition of various organisms. The zones of inhibition of *Bacillus cereus* (Table 4) were significantly higher than those of all the other organisms. The zones of inhibition of *Proteus vulgaris* were not significantly different from those of *E. c.o.li*, *S. marcescens* and those of *Salmonella typhi.* The zones of inhibition of *Salmonella typhi* were not significantly different from those of *E. coli* and *Serratiamarcescens* ($p>0.05$). The inhibition zones of *E. c.o.li* were not significantly different from those of *Serratiamarcescens*($p>0.05$). The inhibition zones caused by the plants extracts were significantly lower than those caused by the positive control against all the organisms ($p<0.001$).

The results obtained in this research show the great potency of the plant *Indigoferaarrecta* to inhibit the growth of all the tested microorganisms. However, as it can be observed from the results it is clear the compounds in the plant have different polarities with high concentration of polar active compounds as evident by high activity of the water and ethyl acetate solvents. The current study is in conformity with the previous studies since similar species of the genus Indigofera have also shown great antibacterial activity. *Indigoferatinctoria*methanol extract demonstrated a great number of active constituents responsible for antibacterial activity. The plant demonstrated activity against methicillin sensitive *Staphylococcus aureus,* methicillin resistant *S. aureus,* Enterococcus species, Streptococcus species and *Moraxella cataruhalis*[27]. According to Sospeter [28], the roots of the plant *Indigoferalupatana* showed great activity against *Bacillus subtilis*, *Klebsiella pneumonia*, *Proteus mirabilis*,*Pseudomonas aeruginosa* and *Salmonella typhimurium*.

CONCLUSION

From this study it may be concluded that the antibacterial activity of the plant is closely attributed to the presence of the important pharmaceutical compounds found in the plant. T.h.e antibacterial activity of the plant could be due to synergistic effect of two or more compounds in the plant. The data obtained in this research is a scientific justification of the plant leaves use in the treatment of various diseases affecting human beings. In the future if more research could be conducted the plant extract could be useful in treatment of infections caused by *Bacillus cereus* viz posttraumatic wounds, self-limited gastroenteritis, burns, surgical wounds infections, and ocular infections such as endophthalmitis, corneal abscess and panophthalmitis [29&30]. The plant extract could also be also be used to treat immunologically compromised patients including AIDS and malignant disease victims [31&32]. The plant's ability to inhibit the growth of *E. coli* is a scientific justification that the plant could be used to treat against enteric infections caused by the bacteria. The plants extract could also be used to treat against gastro-intestinal diseases, ear infections, urinary tract infections and wounds infections caused by *Proteus vulgaris* [33&34].

Salmonella sp. makes one of the most common food poisoning forms all over the world [35]. The data obtained shows that the plant leaves extract could be used to treat against food poisoning caused by *Salmonella typhi*. The plant could also be used to treat against typhoid, paratyphoid fever, traveler's diarrhea, gastroenteritis in adults and gastroenteritis in children [36]. *Indigoferaarrecta*couldbe a good source of active compounds for a variety of diseases affecting human beings in the world today. The plants ability to inhibit the growth of *Serratiamarcescens* shows how the plant could be important to treat against the bacteria which according to Okunda [37]cause nosocomial urinary tract infections. The inhibition of the plant against these bacteria is therefore note worthy since the microorganisms have been found to have resistance against most of the currently used antibiotics. However, further research needs to be done to isolate the active compounds and analyze their structural composition, their mode of action and their effect in the *in vivo* environment.

CONFLICT OF INTERESTS

Declared None

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