



Heavy metal analysis and effect of the crude extract of the leaves of *Bryocarpus coccineus* and *Ficus exasperata* on some pathogenic organisms

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Received: 22 February 2011

Revised: 7 March 2011

Accepted: 8 March 2011

Key words: *Bryocarpus coccineus*, *Ficus exasperata*, extracts.

Abstract

The aqueous and ethanolic extracts of the leaves of *Bryocarpus coccineus* and *Ficus exasperata* were tested for antimicrobial activity on *Pseudomonas aeruginosa*, *Salmonella typhi*, *Enterococcus faecalis*, *Escherichia coli* and *Candida albicans* using disc diffusion method. All the organisms tested against the water and ethanolic extracts of *B. coccineus* were susceptible to the plant extract except for *Pseudomonas aeruginosa* which was resistant to the plant at various concentrations of 50mg/ml, 100mg/ml and 150mg/ml. The mean zones of inhibition of *P. aeruginosa* by water extract of *B. coccineus* range from 2.0mm at 50mg/ml to 5.5mm at 150mg/ml. The water and ethanol extracts of the leaves of *Ficus exasperata* inhibited the growth of all the tested organisms except *Candida albicans* which was resistant to the aqueous extract of the plant at 50,100 and 150mg/ml. The water extract of the two medicinal plants exhibited less inhibitory effect on the tested organisms than its ethanolic extract. Phytochemical screening revealed the presence of flavonoids, tannin, alkanoid, steroid, terpenoid and cardiac glycoside in both medicinal plants without traces of phlobatanin. Saponin is present in *B. coccineus* but not detected in *Ficus exasperata*. The result of analysis for heavy metals confirmed the presence of Mn, Pb, Cr and Zn in both plants within the recommended maximum range of 5.0, 0.3, 2.3 and 9.94mg/kg respectively. The result of this finding suggests the possibility of using the plants for medicinal purposes since they possess antibacterial properties.

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Introduction

Globally, plant extracts are employed for their antibacterial, antiviral and antifungal properties. It is known that more than 400,000 species of tropical flowering plants have medicinal properties and this has made traditional medicine cheaper than modern antibiotics (Odugbemi, 2006). Some plant decoctions are of great value in the treatment of malaria, typhoid fever, diarrhoea or gastrointestinal disorder, urinary tract infections and abscesses (Meyer *et al.*, 1996). Among the most ancient recorded uses of medicinal plants are those found in China and India, where historic approach to the treatment of human diseases is still practiced. A medicinal plant can therefore be defined as any plant which, in one part or more of its organs, contains substances that can be used for therapeutic purpose or which are precursors for the synthesis of useful drugs. A number of plants including *Bryocarpus coccineus* and *Ficus exasperata* have been used in traditional medicine for many years due to their antimicrobial properties (Sofowora, 1993). Specifically, the medicinal value of these plants lies in some chemical substances that produce a definite physiological action on the human or animal body (Edeoga *et al.*, 2005). The most important of their bioactive constituent which are mainly secondary metabolites are alkaloids, flavonoids, tannins and phenolic compounds. These phytochemicals are toxic to microbial cells. *Bryocarpus coccineus* and *Ficus exasperata* have been found to possess inhibitory and bactericidal effect on certain microbial agents.

Bryocarpus coccineus has been used in traditional African medicine (TAM) for the treatment of ear ache, gonorrhoea, impotency, jaundice, piles, sores, tumour and wounds. (Burkil, 1985). It has previously been investigated and reported the analgesic, antidiarrheal (Akindele and Adeyemi, 2006), anti-inflammatory and antipyretic activities of the aqueous leaf extract of the plant (Akindele and Adeyemi, 2007). Ethnobotanical use as a sedative has been ascribed to

B. coccineus. Based on the claim by traditional healers that the plant is effective in the treatment of central nervous system (CNS) diseases, it was investigated for antioxidant activity by Oke and Hamburger (2002).

Decoction of the leaves is applied to sore of mouth and skin, the yorubas of Western Nigeria use the cold infusion of the bruised leaves for gonorrhoea and the plant is considered as a urinary sedative (Ahmadu, 2007). The plant has also been reported as a remedy for diarrhoea (Akindele and Adeyemi, 2006). The oxytocic (Amos *et al.*, 2002), antioxidant (Oke and Hamburger, 2002), and antimicrobial (Kamanzi *et al.*, 2002; Ahmadu *et al.*, 2006) properties of various extracts of the plant have also been reported. *F. exasperata* is traditionally used for treatment of various ailments / disorders in Nigeria and across the African continent. It has been reported by herbal practitioners that the leaves, bark and root are used for treatment of asthma and as antihelminthes. It has also been reported that the leaves are potent inhibitors of intestinal motility and have significant anti-ulcer activity. These claims have been supported by the studies of Ake (1990) and Akah *et al.* (1997 & 1998; Ljeh and Ukwani (2007). At present, it does not appear to be an ingredient in any commercially available health remedies and consumable products (Eric, 2010).

Previous phytochemical analysis carried out on *F. exasperata* and *B. coccineus* had revealed the presence of biological active components such as flavonoid, tannin, saponin. Steroid, alkaloid, phenols, cardioglycoside, terpenoid etc in various parts of the plants – leaves, stem, bark, flower and root (Akindele, 2006). Based on these findings the aim of the study, therefore, was to determine the antimicrobial activities of *Bryocarpus coccineus* and *Ficus exasperata* by conducting the sensitivity (susceptibility) test of the aqueous and ethanolic leaf extract of the plants on some human pathogenic bacteria and fungi, gram negative bacteria species:

Salmonella typhi, *Pseudomonas aeruginosa* and *Escherichia coli*; gram positive bacteria species: *Enterococcus faecalis*, and a fungal specie: *Candida albicans*. To investigate the level of heavy metals in the leaves of *Bryocarpus coccineus* and *Ficus exasperata* and to determine the safety of the plants for consumption.

Materials and methods

Collection of plant samples

The leaves of *Bryocarpus coccineus* and *Ficus exasperata* were obtained from the herbal plant dealers in Mushin market in Odi Olowo – Ojuwoye Local Government Area of Lagos state, Nigeria. The plants were identified in the Department of Biological Sciences, Yaba College of Technology, Nigeria.

Source of test organisms

The test organisms, *Pseudomonas aeruginosa* (27853), *Enterococcus faecalis* (29212), *Salmonella typhi* (28225) and *Escherichia coli* (21922) were obtained from the department of Microbiology, Nigerian Institute of Medical Research (NIMR), Yaba, Lagos while *Candida albicans* (ATCC 90028) was obtained from the Department of Medical Microbiology, College of Medicine, Lagos University Teaching Hospital, Idi-araba. The bacteria were collected in a gelled Macconkey agar while the fungal specie was collected using Sabouraud Dextrose Agar (SDA) slant and refrigerated at 4°C prior to use.

Preparation of sample

400 grams of each plant sample was dried at room temperature for one week. After drying, 350 grams was obtained. The samples were ground and put into containers, labeled and stored in preparation for the extraction process.

Sterilization

Autoclavable materials such as agar and broth were aseptically sterilized in an autoclave at 121°C for 15 minutes. Petri dishes, beakers, McCartney bottles,

pipette, test tubes, filter papers and other metal apparatus such as spatula and forceps were sterilized using hot air oven at a temperature of 160°C for 1 hour. The wire loops were sterilized by heating in the blue flame of the bunsen burner until red-hot and allowed to cool before using 70% alcohol to swab the work bench area to prevent contamination. The process was carried out aseptically.

Extraction procedure

The extraction was done using the soaking method. The ground samples were extracted using water and ethanol as solvent. 100g of the powdered samples were extracted with 1000ml of distilled water while 100g of the samples were extracted with 1000ml of 70% ethanol. The samples were soaked overnight for 24 hours. After 24 hours, the samples were filtered ten times with muslin cloth and the extracts were collected in a round bottom flask, filtered and concentrated, using a rotary evaporator, and then oven-dried at 70°C.

Preparation of culture media

All culture media were prepared according to manufacturers' instructions and autoclaved at 121°C for 15 mins.

Preparation of organisms

Serial dilutions were carried out on the isolates collected from Microbiology Department of Lagos State University Teaching Hospital, Idi-Araba Lagos and Department of Microbiology, Nigerian Institute of Medical Research (NIMR), Yaba. 10^{-4} of the serial dilution was used for the sensitivity testing.

Reconstitution of extract

The dried extracts were reconstituted by dissolving 5g each of the extract in 50ml ethanol and 50ml distilled water. The solution was filtered using the sterile whatman no1 filter paper. The stock solution was sterilized by filtration through filter paper to remove impurities and other contaminants. The stock solution

was further dissolved at different concentrations and it was then stored in sterile universal bottles and refrigerated for further analysis.

Antimicrobial screening for reconstituted extract

Two methods were employed for the antimicrobial testing: Agar diffusion method and Disc diffusion method.

Agar diffusion method

The antimicrobial screening of the ethanolic extracts was done as described by Lino and Deogracious (2006). Nutrient agar was poured in sterile Petri dishes and was allowed to solidify. 1ml of the test culture was dropped on the solidified agar and the organism was spread all over the surface of the agar using a spreader. Wells of approximately 5mm in diameter were made on the surface of the agar medium using a sterile cork borer. The plates were turned upside down and the wells labeled with a marker. Each well was filled with 0.2ml of the extract. Streptomycin disc was used as control for the cultures. The plates were incubated aerobically at 37°C for 24 hours. Sensitivity of the organisms to the extract was recorded.

Disc diffusion method

The locally prepared sterile discs were soaked in the water extract for some hours and nutrient agar medium was poured in sterile Petri Dishes and it was allowed to solidified. 1.0ml of the test organisms was placed on the solidified agar and it was spread all over the surface of the agar. The soaked disc was picked using sterile forceps and it was dropped on the surface of the agar. The plates were incubated at 37°C for 24 hours. Sensitivity of the organisms was recorded.

Test for steroids

Test for steroids was carried out according to Harbone (1989) .2ml of acetic anhydride was added to 0.5g ethanolic extract of each sample with 2ml H₂SO₄. The

colour changed from violet to blue or green indicating the presence of steroids.

Test for terpenoid (salkoliski test)

5ml of each extract was mixed in 2ml chloroform, and concentrated H₂SO₄ (3ml) was carefully added to form a layer. A reddish brown colouration of the interface was formed to suggest positive results for the presence of terpenoids.

Phytochemical analysis

Phytochemical screening was carried out on the obtained plant extracts, according to Okwu (2005).

Qualitative analysis of the constituents

Test for tannins: About 0.5g of the dried powdered sample was boiled in 20ml of water in a test tube and then filtered. A few drops of 0.1% ferric chloride was added and observed for brownish green or a blue black coloration.

Test for phlobatannin: An aqueous extract of the plant sample was boiled with 1% aqueous hydrochloric acid and deposition of a red precipitate was taken as evidence for the presence of phlobatannins.

Test for saponins: About 2g of the powdered sample was boiled in 20ml of distilled water in a water bath and filtered. 10ml of the filtrate was mixed with 5ml of distilled water and shaken vigorously for a stable persistent froth. The frothing was mixed with 3 drops of olive oil, shaken vigorously and then observed for the formation of emulsion.

Test for flavonoids: 5ml of 10% dilute ammonia solution was added to a portion of the aqueous filtrate of the plant extract, followed by addition of concentrated H₂SO₄. A yellow coloration observed in the extract indicated the presence of flavonoid.

Test for cardiac glycosides: 5ml of the extract was treated with 2ml of glacial acetic acid containing one drop of ferric chloride solution (0.1%). This was underlayered with 1ml of concentrated H₂SO₄. A brown ring at the interface indicated a deoxysugar characteristic of cardenolides. A violet ring may

appear below the brown ring, while in the acetic layer, a greenish ring may form just gradually throughout the layer.

Determination of total phenols by spectrophotometer methods

The fat free sample was boiled with 50ml of ether for the extraction of the phenolic component for 15minutes. 5ml of the extract was pipetted into a 50ml flask and then 10ml of distilled water was added. 2ml of ammonium hydroxide solution and 5ml of concentrated amylochohol were made up to mark and left to react for 30min. Colour development was measured at 505nm.

Alkaloid determination

Alkaloid determination was carried out using harborne (1973) method. 5g of the sample was weighed into a 250ml beaker and 200ml of 10% acetic acid in ethanol was added and covered and allowed to stand for 4 hours. This was filtered and the extract was concentrated on a water bath to one quarter of the original volume. Concentrated ammonium hydroxide was added drop wise on the extract until the precipitation was complete. The whole solution was allowed to settle and the precipitate collected and washed with dilute ammonium hydroxide and then filtered. The residue was the alkaloid, which was dried and weighed.

Tannin determination

500mg of the sample was weighed into a 50ml and shaken for 1 hour in a mechanical shaker. This was filtered into a 50ml volumetric flask and made up to the mark. Then 5ml of the filtered was pipetted out into a test tube and mixed with 2ml of 0.1M $FeCl_3$ in 0.1M HCl and 0.008m potassium Ferrocyanide. The absorbance was measured at 120nm within 10min. Van-burden and robinson method (1981).

Saponin determination

The method used was that of Obadoni and Ochuko (2001). Twenty grams of ground samples was put into a conical flask and 100ml of 20% aqueous ethanol was added. The samples were heated over a hot water bath for 4 hours with continuous stirring at about 55°C. The mixture was filtered and the residue re-extracted with another 200ml 20% ethanol. The combined extracts were reduced to 40ml over water bath at about 90°C. The concentrate was transferred into a 250ml separatory funnel and 20ml of diethyl ether was added and shaken vigorously. The aqueous layer was recovered while the ether layer was discarded. The purification process was repeated. Sixty milliliter (60ml) of n-butanol was added to the extracts and washed twice with 10ml of aqueous sodium chloride. The remaining solution was heated in a water bath. After evaporation, the extracts were dried in the oven to a constant weight, and percentage saponin content determined.

Flavonoid determination

Ten grams (10g) of the plant sample was extracted repeatedly with 100ml of 80% aqueous methanol at room temperature. The whole solution was filtered through Whatman filter paper No. 42 (125mm). The filtrate was later transferred into a crucible and evaporated into dryness over water bath and weighed to a constant weight. Boham and Kocipaiabyazan (1974).

Heavy metal analysis

The metals analysed in the crude powdered samples of the leaves of *Ficus exasperata* and *Brysocarpus coccineus* include manganese (Mn), lead (Pb), candium (Cd), zinc (Zn) and chromium (Cr). Samples were analysed using wet digestion method. About 5g of the air – dried powered samples was weighed and placed in a 250ml conical flask and gently heated on a hot plate. Heating was then continued until enough water was driven off for partial carbonization to occur. The beaker was then removed and allowed to cool. A

ratio 1.1 mixture of HNO₃ / H₂O was prepared, and about 5ml of the mixture was added to the ashed sample and warmed slightly for about 5 minutes. The mixture was then filtered using 0.45µm pore size cellulose membrane filter paper (whatman filter paper (Millipore) for Atomic Absorption Spectroscopy (AAS) The stock standard solutions prepared were used to calibrate the instrument after which they were fed into the atomic absorption spectrophotometer for analysis.

Results and discussion

The aqueous and ethanolic extracts of the leaves of *Brysocarpus coccineus* and *Ficus exasperata* were tested against some important human pathogens to determine the antimicrobial activity of the plants and the susceptibility or resistance of the tested isolates on the plant extracts. Table 1- 4 shows the susceptibility and resistance of the organisms to the tested aqueous and ethanol extract of the two medicinal plants. Zones of inhibition were observed around the disc with different radii in mm depending on the degree of resistance of the organism to the extract at different concentrations of 50, 100 and 150mg/ml.

Table 1. Mean zones of inhibition of ethanolic extract of the leaves of *Brysocarpus coccineus* on the tested isolates.

Tested organisms	Concentration (mg/ml)			Ciprofloxacin +ve control 100mg/ml	DMF -ve control 1ml
	50	100	150		
<i>P. aeruginosa</i>	0.0	0.0	0.0	18.2	0.0
<i>S. typhi</i>	3.0	5.1	7.0	14.0	0.0
<i>E. faecalis</i>	1.6	3.0	5.0	12.0	0.0
<i>E. coli</i>	2.2	2.5	4.2	13.4	0.0
				Ketaconaz-ole	
<i>C. albicans</i>	2.2	3.0	6.0	14.0	0.0

The ethanol extract of *B. coccineus* was potent to all the organisms at 50mg/ml, 100 mg/ml and 150mg/ml except for *Pseudomonas aeruginosa*. *S. typhi*

recorded the lowest zone of inhibition of 1mm, 2mm, and 3mm at 50, 100 and 150mg/ml with aqueous extract of *B. coccineus*. The aqueous extract of *Ficus exasperata* was not potent to *Candida albicans*. The highest zones of inhibition were recorded at 150mg/ml with *Pseudomonas aeruginosa* (6.0mm) Table 4. The positive control ciprofloxacin recorded the widest zone of inhibition to all the tested organisms at 22mm (Table 4). The result of antimicrobial activity of the water and ethanol extract of the leaves of *Brysocarpus coccineus* and *Ficus exasperata* against *Pseudomonas aeruginosa*, *Enterococcus faecalis*, *Salmonella typhi*, *Escherichia coli* and *Candida albicans* showed that the plant extracts possess antimicrobial properties and can be effective antibiotics since they inhibited the growth of wide range of bacterial and fungal causative agents of skin and eyes irritation, candidiasis, tumours, gonorrhoea, jaundice, piles, wound, etc. This observation is similar to the previous studies of Akindele and Adeyemi (2007).

Table 2. Mean zones of inhibition of the aqueous extract of the leaves of *Brysocarpus coccineus* on the tested organisms.

Tested organisms	Concentration (mg/ml)			Ciprofloxacin +ve control 100mg/ml	DMF -ve control 1ml
	50	100	150		
<i>P. aeruginosa</i>	2.2	4.0	5.5	22.0	0.0
<i>S. typhi</i>	1.6	2.2	3.0	12.2	0.0
<i>E. faecalis</i>	5.0	5.6	7.4	10.5	0.0
<i>E. coli</i>	3.0	4.1	6.0	14.6	0.0
				ketaconazole	
<i>C. albicans</i>	2.2	3.8	4.6	18.2	0.0

All the microorganisms tested against the water and ethanol extracts of the leaves of *B. coccineus* were susceptible to the plant extracts at different concentration except *Pseudomonas aeruginosa* that was resistant to the ethanol extracts at different concentration used. The susceptibility of the

organisms (zones of inhibition) increases progressively with increase in the concentration of extract from 50mg/ml to 150mg/ml. The antibiotics (Ciprofloxacin and Ketaconazole) used as positive control at the concentration of 100mg/ml show the widest range of inhibition. This confirmed the effectiveness of the drugs in combating or treating infections association with the tested organism Adebayo *et al.* (2009).

Table 3. Mean zone of inhibition in mm (radius) of the ethanolic extract of the leaves of *Ficus exasperata* on the tested microorganisms.

Tested organisms	Concentration (mg/ml)			Ciprofloxacin +ve control 100mg/ml	DMF -ve control 1ml
	50	100	150		
<i>P. aeruginosa</i>	4.0	6.0	7.8	14.2	0.0
<i>S. typhi</i>	0.0	2.2	5.4	14.8	0.0
<i>E. faecalis</i>	1.5	3.0	5.2	13.2	0.0
<i>E. coli</i>	2.0	4.0	6.2	14.0	0.0
				ketaconazole	
<i>C. albicans</i>	2.5	3.5	7.0	14.0	0.0

Table 4. Mean zone of inhibition of aqueous extracts of the leaves of *F. exasperata* on the tested microorganisms.

Tested organisms	Concentration (mg/ml)			Ciprofloxacin +ve control 100mg/ml	DMF -ve control 1ml
	50	100	150		
<i>P. aeruginosa</i>	2.0	4.0	6.0	18.0	0.0
<i>S. typhi</i>	0.0	1.0	7.2	15.0	0.0
<i>E. faecalis</i>	1.4	2.6	4.4	21.0	0.0
<i>E. coli</i>	2.0	3.4	4.8	16.0	0.0
				ketaconazole	
<i>C. albicans</i>	0.0	0.0		22.0	0.0

There was no zone of inhibition by the dimethyl formamide (DMF) used as negative control. This implies that, the susceptibility of the organism to the different concentrations of the extract used was not

due to the solvent (DMF) used for the reconstitution of the extract but due to the active component of the plant such as flavonoid, tannin, saponin (Akindele *et al.*, 2006). However the water and ethanol extract of the leaves of *Ficus exasperata* inhibited the growth of all the tested organisms as indicated by the zone of inhibition except for *Candida albicans* which was resistant to the water extract of the plant at various concentrations used. The susceptibility also increases with increased concentration of the extract. Observation from this work shows that the water extract from the two medicinal plant exhibited less inhibitory effect on the tested isolates than it ethanol extract. This implies that the crude water extract of this plant could not be more suitable in tackling diseases caused by the tested organisms as is sometimes used by the local herbal sellers (Adebayo, 2009). Investigation in the past has also clearly shown that the ethanol extracts were more effective than water extracts due to some active component present in them which are absent in water extract (Ibekwe *et al.*, 2001 and Dulta, 1993). They have attributed this observation to the high volatility of ethanol which tends to extract more active compound from the sample than water, hence this study follows a similar trend. The absence of this active compound from the water extract may account for the resistant of *Candida albicans* to the water extract of *Ficus exasperata* (Table 4). *Escherichia coli*, *Enterococcus faecalis*, *Salmonella typhi*, etc are enteric organism dwelling in the intestine of man and are the causative agents of gastro intestinal disorders.

This work therefore provides a scientific justification for the use of the plant extracts in combating ailments associated with enteric bacteria (gastroenteritis) as clearly indicated by the bacteriostatic effect of the plant on the tested bacteria. However, a comprehensive study of the previous work of Eric, (2010) and Adebayo, (2006) on the antimicrobial activity of the plant extracts on the tested organisms yielded similar result.

Furthermore, phytochemical screening analysis carried out on both extracts of *Ficus exasperata* and *Bryocarpus coccineus* revealed the presence of various chemical components – flavonoid, tannin, alkaloid, steroid, terpenoid and cardiac glycoside in both medicinal plants without presence of phlobatannin (Table 5). This observation is similar to the studies of Amos *et al.* (2002), Edeoga (2005) and Akindele (2006). Also, saponin was detected in the extract of *B. coccineus* but not present in the extract of *Ficus exasperata*. This may account for the reason why *Candida albicans* was resistant to the extract of the plants at various concentrations.

Table 5. The phytochemical compound present in the crude extract of *Bryocarpus coccineus* and *Ficus exasperata*.

Active components	<i>Bryocarpus coccineus</i>	<i>Ficus exasperata</i>
Alkaloid	Present	Present
Tannin	Present	Present
Flavonoid	Present	Present
Phlobatannin	Not present	Not present
Saponin	Present	Not present
Steroid	Present	Present
Terpenoid	Present	Present
Cardiac glycoside	Present	Present

The biological function of flavonoid includes protection against allergies, inflammation, platelets aggregation, ulcers and tumours. This may be the reason behind the use of the extracts in the treatment of intestinal disorders. The presence of tannin in these plants strongly supports their use in the treatment of wounds, burns and hemorrhoids in herbal medicine (Doherty *et al.*, 2010). Also, the presence of phenolic compounds in the plants confirmed their use as antimicrobial agent because phenol and phenolic compounds have been extensively used in disinfection and remain the standard with which other bacteria are compared (Edeoga, 2005).

Table 7 shows the result of screening for the plants for heavy metals. The result revealed the presence of manganese (Mn), lead (Pb), chromium (Cr) and zinc (Zn) which are within the normal range when compared with the recommended maximum standard concentration. There was no trace of cadmium in both plant samples.

Table: 6. Percentage composition of active ingredients of the crude extracts of *Bryocarpus coccineus* and *Ficus exasperata*.

PLANTS	% Flavonoid	% Alkaloid	% Saponin	% Total phenol
<i>B. coccineus</i>	0.349	1.188	2.660	1.720
<i>F. exasperata</i>	0.478	1.850	1.780	1.370

Table 7. Concentrations of heavy metals in *Bryocarpus coccineus* and *Ficus exasperata*.

Metals	<i>B. coccineus</i>	<i>F. exasperata</i>	Rec. max level
Manganese	0.028	0.021	5.0
Lead	0.016	0.011	0.3
Cadmium	Not detected	Not detected	0.2
Zinc	0.017	0.201	9.94
Chromium	0.011	0.010	2.3

Recommended Maximum level =FAO/WHO standard (Codex Alimentarius Commission, 2001).

There was no trace of cadmium in both plant samples. Mn, Pb, Cr, and Zn were present at the concentrations of 0.028, 0.016, 0.011 and 0.017mg/g for *Bryocarpus* extract and 0.021, 0.011, 0.010 and 0.201 mg/g for *Ficus exasperata* respectively. Among all the metals screened, Zinc (Zn) had the highest concentration value of 0.201mg/g in *F. exasperata*. The result of this finding indicated that *Ficus exasperata* and *B. coccineus* contains the required range of heavy metals tested. Some heavy metals could be harmful or detrimental to the human system. For instance, cadmium can cause severe gastro intestinal irritation, vomiting, diarrhoea and excessive salivation. Low level chronic exposure to cadmium

can cause adverse health effects including gastrointestinal, hematological musculoskeletal, renal, neurological and reproductive disorders. The main target organ for Cadmium following chronic oral exposure is the kidney (Othman, 2001) and (Kumar, 2007). Heavy metal poisoning can result when these metals are present in excessive amounts in the biological system but the result of this work shows that both medicinal plants tested are safe for human consumption since the heavy metals present does not exceed the maximum recommended value.

Conclusion

With reference to the investigation, it can be concluded that the extracts of *Ficus exasperata* and *Bryocarpus coccineus* possesses antimicrobial properties and could therefore serve as alternative therapy in the treatment of infections associated with the tested organisms such as intestinal disorders (gastroenteritis), tumours, swelling, gonorrhoea, inflammation, stomatitis, earache, diarrhea, ulcers, jaundice, sores, piles, wounds etc. The plants however are safe for human consumption since the concentrations of heavy metals are within the respective recommended levels. Further studies however need to be carried out to determine the health effects of excessive levels due to long period of consumption of contaminated plants. It is therefore suggested that regular monitoring of heavy metals in plants and other food items should be done in order to prevent excessive buildup of these heavy metals in the human food chain. Appropriate precautions should also be taken at the time of transportation and marketing of these plants.

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