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Evaluation of *in-vitro* antioxidant, anti-inflammatory and diuretic potential of an ethanol extract of *Sanseviera liberica* leaves on wistar albino rats

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Abstract

Sansevieria liberica is a genus of floweringplant in the family of Asparagaceae, it is a medicinal plant mostly used in the herbal medicine to cure Abdominal pains, diarrhea, piles, asthma and snakebites. Cold ethanol extract in leaves of *Sansevieria liberica* were investigated on Anti-inflammatory and Diuretic activities in albino rats that were compared with the standard drugs Aspirin (300 mg/kg) and furosemide (40 mg/kg) respectively. The extract were administered based on high and low doses, 400 mg/ml, 200 mg/ml, 100 mg/ml, 50 mg and 25 mg/ml, the extracts of *Sansevieria liberica* leaves produced a doses-dependent inhibition of acid-induced rat paw oedema, a parameter to show that it has anti-inflammatory activity. The extracts at high concentration were found to induce inflammation with time interval. Highest inhibition was seen in extract with high doses. In diuretics, it shows a low reduction at low concentration of 50 mg and 25 mg respectively. The results obtained were subjected to one-way ANOVA at $p < 0.05$) level of significance. When compared to the negative control (the normal saline) and the positive control, (the furosemide), the volume of urine level decreased significantly ($p<0.05$) in rats that received 50 mg and 25 mg/ml of the extract. The urine volume levels was insignificant ($p>0.05$) in rats given 400 mg, 200 mg and 100 mg/ml of the extract. The antioxidant activity was determined using nitric oxide, 2,2–diphenyl-1-picrylhydrazyl, lipid peroxidation free radical scavenging activities. The plant extract showed (95.75 %) inhibition in nitric oxide at the highest concentration (200 µg/ml) used. This is higher when compared to lipid peroxidation (95.22 %) and 2,2-diphenyl-1- picrylhydrazyl (92.48 %) respectively. The percentage inhibition of the plant extract showed low inhibition concentration as against 50 % (IC_{50}). Isolation and purification of the specific bioactive principles could serve to improve the free radical scavenging potency of the plant. Conclusively, this study confirms that *Sansevieria liberica* has anti-inflammatory, antioxidant and diuretics efficacy.

Keywords antioxidant, anti-inflammatory, dose-dependent, diuretic, lipid peroxidation, medicinal

Introduction

With the onset of research in medicine, it was concluded that plants contain active metabolites which are responsible for curative action of the herbs. Nature has provided a complete store house of remedies to cure all ailments of mankind [1]. This is where nature provides us with drugs in the form of herbs, plants and algae to cure the incurable diseases without any toxic effect.

Medicinal plants are those plants which are rich in secondary metabolites such as alkaloids, glycosides, Flavonoids, steroids etc, and they are important source of new chemical substances with potential therapeutic effects. They have

formed the basis of traditional medicine. Nowadays, plants are important sources of medicines especially in developing countries that still use plant based traditional medicine.

Among the medicinal plants used, *Sanseviera Liberica* is used in traditional medicine for various purposes. The leaf sap is applied to ulcers, sores and tropically incase of earache and toothache [2]. As a fetish plant it is grown on graves, at shrines and in compounds [3]. In Africa, the leaves are used for fibre production [4], the plants sap has antiseptic qualities and the leaves are used for bandages in traditional first aid [5]. *Sansevira Liberica* has a high content of antimicrobial agents which is normally used as an antioxidant, inflammatory and diuretic [6].

Inflammation is considered a primary physiological defense mechanism that helps the body to protect itself against infection, burn, toxic chemicals and noxious stimuli. An uncontrolled and persistent inflammation may act as an etiologic factor much chronic illness [7]. The cardinal signs of inflammation are redness, heat, swelling, pain and loss of function of the affected area. There are two basic types of inflammations; acute and chronic inflammation.

Acute inflammation has a short duration and is the initial response of the body to harmful stimuli. It is medicated by histamine, bradykinin. There are certain disease conditions that can result in acute inflammation they are acute bronchitis, dermatitis, sore throat and appendicitis.

Chronic inflammation has a long duration and the major cell involved are lymphocytes, macrophages and plasma cells. Examples of disease conditions with chronic inflammation are; rheumatoid arthritis, peptic ulcer and chronic active hepatitis.

Diuresis is a condition where urine production is increased. It is accompanied by these symptoms; fatigue, polyuria (a condition of eliminating abnormally large amount of urine). Diuresis can be caused by the kidney; the accumulation of these substances results in the reabsorption of water, this form of dieresis is called osmotic dieresis. It is also caused by high blood sugar [8]. Diuresis caused by the use of diuretics is referred to as forced diuresis.

Diuresis can be used by renal failure, polydipsia (increased thirst), diabetes mellitus, hyperglycemia and renal obstruction. Diuretics are drugs used to increase the amount of urine produced by the kidneys and increase the excretion of electrolytes such as sodium and potassium [9]. They act by inhibiting tubular reabsorption and also increase the elimination of water and electrolytes [10].

An antioxidant is a molecule that inhibits the oxidation of other molecules. Oxidation is a chemical reaction that transfers electrons or hydrogen from a substance to an oxidizing agent. The use of antioxidant in pharmacology is intensively studied, particularly as treatments, for stroke and neurodegenerative disease [11]. We have types of antioxidants such as non- marine antioxidants example ascorbic acid (Vitamin C), polyphenols and tocopherols (Vitamin E).

Sansevieria liberica (leopard lily) is commonly used in folk medicine for a variety of remedies, therefore these experiments was carried out to justify the efficacy of the anti- oxidant, anti- inflammatory and diuretic effect of *Sanseviera liberica* leaves included in wistar albino rats. Therefore research into the therapeutic effect is expected to protect the human body from diseases such as eczema, hypertension, diarrhea and gonorrhea.

Materials and Methods

Collection of Plant Materials

Fresh leaves of *Sanseviera liberica* were purchased from Osusu in Aba North Local Government Area of Abia State. It was then identified and authenticated by Dr. Omosun Garuba of the department of Plant Science and Biotechnology Michael Okpara University of Agriculture, Umudike. A voucher specimen (Herbarium No. 1321) was deposited in the Herbarium of the department of plant science and biotechnology, College of Natural sciences.

Preparation of Plant Extract

The leaves were air dried for a period of two weeks at room temperature. The dry leaves were then taken for pulverizating machine ED-1 in the department of Soil Science, National Root Crop Research Institute, Umudike. 50 grams of the fine powder of *Sanseviera liberica* was weighed using Triple Beam Balance MB2610.200ml of 95% ethanol was added to the plant materials in a beaker. It was then allowed to stand for 72 hours at room temperature and filtered using Whatman No. 1 filter paper. The filtrate was concentrated at 50^0 Cuniscope water bath, in order to evaporate.

Experimental Animals

Wistar albino mice (30-33g) and wistar albino rats (150-200g) of either sex were used in the study. They were procured from the animal house of the department of Zoology university of Nigeria Nsukka, Enugu state, Nigeria.

The animals were housed in metal cages and randomly distributed. They were kept in the university animal house and allowed for acclimatization period lasting for 14 days (2 weeks) prior to use for any experiment. The animals had access to clean water and standard laboratory animal feed.

Experimental Design

Acute Toxicity (Lethal Dose)

A total of 20 white wistar albino mice were used as animals. The animals were of average weight of 33 g. Five groups of four animals each were used. The plant extract was administered to the animals intraperitoneally (I.P) at the doses of 62.5 mg/kg, 125 mg/kg, 250 mg/kg, 500 mg/kg and 1000 mg/kg body weight respectively. The animals were observed for a maximum of 24 hours separately.

The lethal-dose 50 was calculated using the following formula (Udoh, 2007)

LD_{50} √ conc with the highest death × lowest conc. Without death.

LD_{50} $\sqrt{1000 \times 50} = 500 = LD_{50}$ = 500 mg/dl.

Anti-inflammatory Study

A total of 24 adult albino wistar rats of both sexes were used, they were of average weight of 150 g. They were all placed in cages and grouped into seven (A-G) of four animals per group. They were then left to acclimatize for four days. The animals were deprived of feed for 12 hours prior to the experiment but were allowed access to pure drinking water. They were not allowed access to both feed and pure drinking water during the experiment. The crude extract and aspirin was separately administered intraperitoneally. Group A was used as negative control thus received neither aspirin nor the crude extract. Group B received intraperitoneally 500 mg/kg, Group C received 250 mg/kg, Group D received 125 mg/kg, Group E received 62.5 mg/kg, Group F received 15.5 mg/kg and Group G was used as positive control, thus received 100 mg of aspirin intraperitoneally. The animals were left for 30 minutes after which 1 ml of fresh egg albumin was injected into the sub-planter of the right hind paw of each of the rat. Using a Vernier caliper, the diameter of the right hind paw was measured at 30 minutes interval of 30 minutes, 60 minutes, 90 minutes, 120 minutes, 150 minutes and 180 minutes respectively. Percentage inflammations were calculated with the formula below;

Inhibition of edema %= $(C_0-C_t) * 100/C_0$

Where, C_O = Inflammation of control. C_t = inflammation of test.

Diuretic Activity

The method of Murugesan *et al.*, 2000 [12] was employed for the assessment of diuretic activity. Male albino rats weighing between 120-150 g deprived of food and water for 18 hours prior to the experiment. They were divided into 7 groups at two rats per group. The first group of animal served as negative control received normal saline , the second group received 40 mg/kg body weight respectively . immediately after administration , the animals were in metabolic cages (2 per ages) specifically designed to separate urine and faeces after which the volume of the urine collected was measured at the end of 24 hours. During this period, no food and water was made available to the animals. The parameters taken were total urine volume, concentration of sodium ion, potassium ion, chloride ion and bicarbonate in the urine. Sodium and potassium ion concentration were determined by flame photometer [13]. Chloride and bicarbonate concentration was estimated (using three drops of potassium chromate solution as indicator).

Antioxidant Study

DPPH (2-2-diphenyl-1- picrylhydrazyl) scavenging activity

The determination of DPPH stable radical scavenging activity of the *Sansevieria liberica* extract was based on the method as described [14]. Briefly, one milliliter of aliquots of the extract and standards (control, 200 mg, 100 mg, 50 mg, 25 mg, and 100 mg of vitamin C) was added to MeOH solution of DPPH (5 ml, 0.1 mM) and vortexed. After 20 minutes reaction at 25 ^{o}C, the absorbance was measured at 517 nm against a blank in a UV-Vis spectrophotometer. BHT was used for comparison. The percentage quenching of DPPH was calculated as follows; inhibition of DPPH. (%)=1- $samples_{517nm}/control_{517nm} \times 100$, where, $Samples_{517nm}$ was absorbance of the sample and $Control_{517nm}$ was absorbance of control. The results were expressed as $IC_{50,}$ which means the concentration at which DPPH radicals were quenched by 50 %.

Nitric Oxide (NO) Scavenging Activity

Nitric oxide (NO) generated from sodium nitroprusside (SNP) in aqueous solution at physiological pH was estimated by the use of Griess reaction with minor changes [15]. The reaction mixture (3 ml) containing SNP (10 Mm, 2 ml), phosphate buffer saline (0.5 ml) and the ethanol extract of *Sanseviera liberica* at different concentrations and standards (control, 200 mg, 100 mg, 50 mg, 25 mg and 100 mg of vitamin C) were incubated at 25 °C for 150 minutes. After incubation, 0.5 ml of the incubated solution containing nitrite was pipetted and mixed with 1 ml of sulfanilic acid reagent (0.33 % in 20 % glacial acetic acid) and allowed to stand for 5 min for completing diazotization. Then, 1 ml of N-1-naphthyl ethylenediamine dihydrochloride was added, mixed and allowed to stand for 30 min at 25 °C. The absorbance of pink coloured chromophore formed during diazotization was immediately measured at 540 nm in a UV-Vis spectrophotometer. BHT and catechin were used for comparison. The percentage scavenging of NO (nitric oxide) was calculated as follows; inhibition of NO (1%) = 1-Sample $_{540nm}$/Control$_{540nm}$ × 100, where, Samples$_{540nm}$ was absorbance of the sample and Control$_{540nm}$ was absorbance of control.

Anti-lipid Peroxidation Activity

Lipid peroxidation was estimated by measuring spectrophotometrically the level of the lipid peroxidation product, malondialdehyde (MDA) as described [16]. Lipid degradation occurs forming such products as malondialdehyde (from fatty acids with two or more double bonds), ethane and pentane (from the n-terminal carbons of 3 and 6 fatty acids respectively). MDA reacts with thiobarbituric acid to form a red or pink colored complex which in acid solution absorbs maximally at 532 nm.

Procedure

A volume, (control, 200 mg, 100 mg, 50 mg, 25 mg, 100 mg of vitamin C) was mixed with 0.9 ml of H_2O in a test tube. A volume, 0.5 ml of 25 % TCA (trichloroacetic acid) and 0.5 ml of 19 % TBA (thiobarbituric acid) in 0.3 % NaOH were also added to the mixture. The mixture was boiled for 40 minutes in water bath and then cooled in cold water. Then 0.1 ml of 20 % sodium dodecyl sulfate (SDS) was added to the cooled solution and mixed properly. The absorbance was taken at wavelength 532 nm and 600 nm against a blank.

% inhibition = ((A control –A sample) X 100)/A control

Statistical Analysis

The data obtained is expressed as mean ± standard error for the number of animals in each group (n=2). Data obtained from negative control group were used as baseline. The data obtained was analyzed using the one way analysis of variance (ANOVA) in all cases, statistical significance was established at values ($p< 0.05$).

Results

The anti-inflammatory activity of ethanol leaf extract of *Sanseviera liberica* in egg albumin induced hind paw oedema in rats was evaluated and the results were shown.

Table 1: Result of average inflammation of hind paw (oedema) using 2 mg/ml of fresh egg albumin in diameter (mm)

Group	30 mins	60 mins	90 mins	120 mins	150 mins	180 mins
400 mg/ml	0.506±0.11	0.420±0.03	0.345±0.11	0.286±0.03	0.204±0.07	0.125±0.03
200 mg/ml	0.566±0.01	0.489±0.03	0.452±0.07	0.325±0.03	0.285±0.03	0.245±0.11
100 mg/ml	0.620±0.03	0.588±0.03	0.504±0.07	0.478±0.03	0.400±0.03	0.375±0.03
50 mg/ml	0.785±0.07	0.705±0.03	0.686±0.07	0.615±0.03	0.567±0.07	0.455±0.07
25 mg/ml	0.825±0.03	0.790±0.03	0.708±0.07	0.688±0.03	0.609±0.03	0.523±0.07
aspirin(100 m)	0.160±0	0.152±0	0.146±0.03	0.135±0.03	0.124±0.03	0.112±0.03
Normal Saline	0.658 ±0.03	0.708±0.03	0.825±0.07	0.935±0.03	1.165±0.03	1.453±0

The result obtain in average inflammation of hind paw (oedema) indicates that the extract has significant ($p<0.05$) anti-inflammatory activity in rats at all doses.

Table 2: Result of percentage inflammation (oedema) per time intervals using non-treated animals as control

Doses	30 mins	60 mins	90 mins	120 mins	150 mins	180 mins
Extract 400 mg/ml	76.89±0.11	59.32±0.03	41.82±0.11	30.59±0.03	17.51±0.07	8.60±0.03
Extract 200 mg/l	86.01±0.01	69.07±0.03	54.79±0.07	34.76±0.03	24.46±0.03	16.86±0.11
Extract 100 mg/l	94.22±0.03	83.05±0.03	61.09±0.07	51.12±0.03	34.33±0.03	25.81±0.03
Extract 50 mg/l	119.30±0.07	99.57±0.03	83.15±0.07	65.78±0.03	48.67±0.07	31.31±0.07
Extract 25mg/l	125.38±0.03	111.58±0.03	85.82±0.07	73.58± 0.03	52.27±0.03	36.61±0.07
Aspirin 100mg/ml	24.62±0.00	21.32±0.00	17.69±0.03	14.43±0.03	10.64±0.03	7.70±0.03

The percentage inflammation increases as the dose level decreases and decreases as time interval increases, the result shows that 25 mg/kg concentration of the extract had the highest anti-inflammatory effect and it was significant at various time intervals ($p< 0.05$).

Table 3: Result of percentage inhibition (oedema) per time intervals

Doses	30 mins	60 mins	90 mins	120 mins	150 mins	180 mins
Extract 400 mg/ml	23.10±0.11	40.67±0.03	58.18±0.11	69.41±0.03	82.48±0.07	91.39±0.03
Extract 200 mg/l	13.98±0.01	30.93±0.03	45.21±0.07	65.24±0.03	75.54±0.03	83.14±0.11
Extract 100 mg/l	5.77±0.03	16.94±0.03	38.91±0.07	48.87±0.03	65.67±0.03	74.19±0.03
Extract 50 mg/l	19.30±0.07	9.46±0.03	16.84±0.07	34.22±0.03	51.33±0.07	68.68±0.07
Extract 25 mg/l	25.37±0.03	11.58±0.03	14.18±0.07	26.41±0.03	47.73±0.03	64.09±0.07
Aspirin 100 mg/ml	75.68±0.03	78.53±0.03	82.30±0.03	85.56±0.03	89.36±0.03	99.88±0.03

The concentration doses of the extract increases as the time interval increases.

Table 4: Results of percentage inhibitory effect of Nitric oxide

Concentration	% inhibition activity	
(µg/mg)	% inhibition	Standard (IC_{50} =100mg/ml)
200	96.75±1.59	
100	81.38± 1.56	94.25±1.16
50	45.44±5.44	
25	9.98±3.80	

There is decrease in the percentage inhibition with decrease in dose level: hence, shows a significant ($p< 0.05$) increase in percentage inhibition of nitric oxide group A (200) when compared against the standard group.

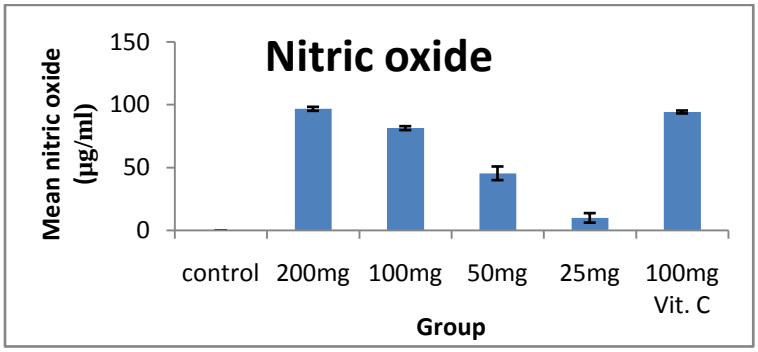

Figure 1: Inhibition of Nitric oxide

Table 5: Results of average percentage scavenging of DPPH (2-2- diphenyl -1- picrylhydrazyl)

Concentration	% inhibition activity	
(µg/mg)	% inhibition	Standard (IC_{50} =100mg/ml)
200	92.48±2.18	
100	71.82±8.19	96.43±0.00

From the above table, there is a significant ($p< 0.05$) decrease in percentage inhibition of DPPH of the treated groups when compared against the standard group.

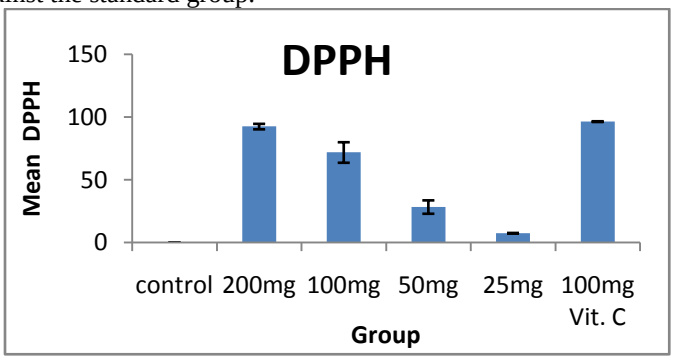

Figure 2: Percentage scavenging of DPPH

Table 6: Result of percentage scavenging of Anti-lipid peroxidation

Concentration (µg/mg)	% inhibition activity	
	% inhibition	Standard (IC_{50} =100mg/ml)
200	95.22±0.76	
100	64.96±10.63	94.69±0.74
50	38.45±3.23	
25	18.30±1.19	

From the above table, there is a significant ($p< 0.05$) decrease in percentage inhibition of anti-lipid peroxidation, group A (200) when compared against the standard group.

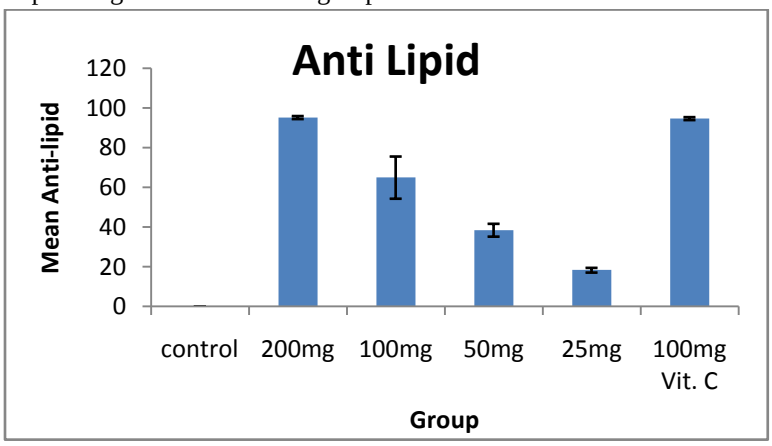

Figure 3: Percentage scavenging of Anti-lipid peroxidation

Diuretic effect of ethanol leaf extract of *Sanseviera liberica* on urinary electrolyte excretion

Table 7: Result of the urinary electrolyte excretion

Concentration	Na^+ (meq/l)	K^+ (meq/l)	Cl^- (meq/l)	HCO_3^- (meq/l)	Na^+/K^+ Ratio
Control 1(Normal Saline)	95.5±0.98	4.9±0.14	85.3±1.3	29.5±0.71	19.5±0.76
Control 2(Furosemide)	131.1±1.56	11.9±0.13	100.7±0.72	31.55±0.64	11±0.01
400mg/ml	121.63±1.12	7.75±0.14	84.87±0.18	30.5±2.12	15.7±1.56
200mg/ ml	99.82±0.25	5.75±0.13	65.94±0.37	30.5±0.71	17.36±0.34
100mg/ ml	63.36±1.24	4.48±0.3	48.89±0.48	27.5±0.71	14.18±0.69
50mg/ ml	37.4 ±1.29	2.86±0.14	35.70±0.59	31.0±1.41	13.1±0.23
25mg/ ml	24.89±1.76	1.18±0.08	23.77±1.3	28.5±3.54	21.09±0.01

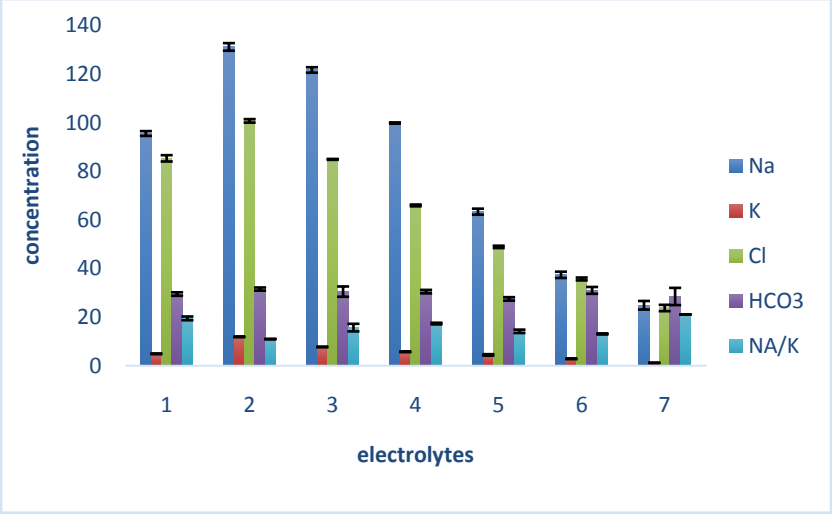

Figure 4: Result of urinary electrolyte

Diuretic Activity

The results of screening the ethanol leaf extract of *Sanseviera liberica* for diuretic activity as shown in table 7 and fig 3 and 4. The extract increased urine output at higher concentration of 400 and 200mg/kg ; this is similar to the dieresis obtained with furosemide which produced a significant ($p<0.05$) when compared with the control. Administration of the test drug significantly enhanced urinary excretion of the electrolytes and increased urine volume. The urinary excretion of the electrolytes increased. However there was no significant difference between the treatment groups of HCO_3^-($p> 0.05$). The Na^+/K^+ increased as the dose levels decreased hence there was a significant difference ($p< 0.05$) within the different dose levels.

Diuretic Effect of Ethanol Leaf Extract of *Sanseviera liberica* on Urine Volume

Table 8: Effect of ethanol extract of *Sanseviera liberica* on urine volume

Concentration	Volume of Urine (ml)
Control 1 (Normal Saline)	0.15±0.07
Control 2 (Furosemide) (40 mg/ml)	2.9±0.14
400 mg/ml	1.3±0.14
200 mg/ml	0.8±0.14
100 mg/ml	0.25±0.04
50 mg/ml	0.075±0.021
25 mg/ml	0.04±0.028

From the above table, it shows a low reduction at low concentration of 50 mg and 25 mg respectively when compared with the negative control (normal saline) and the positive control (furosemide).

DISCUSSION

Sansevieria liberica had been reported to have important use and a medicinal plant and the phytochemical screening which showed the presence of alkaloids, flavonoids, saponin and tannins was reported [17]. The ethanol effect on the nitric oxide effect of *Sanseviera Liberica* (table 4) exhibited a concentration dependent scavenging effect. The effect increased with increase in concentration. The extract showed highest inhibition of 96.75% at a concentration of 200µg/ml. Base on the Inhibitory conc. (IC_{50}) of a substance, this means that ethanolic extract of *Sansevieria Liberica* will have to reduce its quality of antioxidant compounds, in order to be equivalent with the ascorbic acid to effectively reduce the oxidant in the reaction matrix.

Antioxidant capacity of ascorbic acid has been used as a reference standard from which plant extracts with potential antioxidant activity are compared [18]. In table 5: The DPPH assay has been largely used as a quick, reliable and reproducible parameter to search for invitro antioxidant activity of pure compounds as well as plant extracts [19]. The effect of the ethanolic extract of *Sanseviera Liberica* at different conc. Based on the DPPH scavenging activity showed that scavenging effect increased with increase in concentration.

Highest inhibition of 92.48% was seen at the concentration of 200µg/ml. since inhibitory conc. (IC_{50}) of a substance is at 50%, this implies that the potency of the extract with respect to DPPH scavenging activity can be obtained at a higher dose of the extract.

The result of the ethanolic extract of anti-lipid peroxidation of *Sansevieraliberica* is shown in the **table 6**. At the highest concentration (200mglm) of the extract of *Sanseviera liberia*, the percentage inhibition in anti-lipid peroxidation was as 22% against 50%.

On the other hand, the extract produced a percentage decrease in anti-lipid peroxidation at the percentage inhibition of 18.30% of the lowest concentration used (25mglml) with mean inhibitory comic. ($1C_{50}$) as 94.69 µg/ml. This result means that the plant has much antioxidant to effectively inhibit the oxidation of lipid peroxidation. *Sansevieria liberica* has been demonstrated in this study to have antioxidant effect since the administration of aspirin did not cause accumulation of inflammation level and furosemide did not cause accumulation of diuretics level of the rats and this is consistent with the findings as reported by several studies [17]It is possible that an antioxidant activity of the plant is as a result of its constituents such as vitamin E and C. Vitamin C works synergistically with vitamin E to quench free radicals and also regenerates the reduce form of vitamin E [20]. Vitamin C as an antioxidant may prevent cataracts in the body [21]. Vitamin E had been reported to safe guard cell from damage by free radicals and heart disease [21]. Its antioxidant function mainly reside I the perfection against lipid peroxidation [20].

As revealed in the diuretic activity in this study, the evidence of the diuretic response was observed in rats treated with furosemide and the plant extract. The leaves of *Sanseviera Liberica* significantly increased urine volume at high doses of 400mglml and 200mg/ml and also enhanced urinary electrolyte excretion.

Furosemide inhibits electrolyte reabsorption in the thick ascending loop of the nephron which leads to retention of water in the urine. It inhibits Na^+ andCl^- reabsorption, it was observed that there was increased in Na^+ and Cl^- excretion. The presence of saponin in the phytochemical screening also have contributed to the diuretic effect as saponin have been reported to be involved in plant diuretic responses.

As revealed in the anti-inflammatory activity in this study, the most widely used primary test to screen new anti-inflammatory agents measured the ability of a compound to reduce local oedema induced in the right paw by injection of an irritant agent [22]. Egg albumin induced oedema has been commonly used as an experimental animal model for inflammation.

Table 1, shows the effect of various treatment groups with regards to the mean hind paw diameter. Anti-inflammatory data for the leaf of *Sanseviera Liberica* indicated reduction in the induced oedema which was significant ($p<0.05$).

This clearly shows that the leaves extract administered at different dose concentrations demonstrated a good anti-inflammatory activity that was dose dependent.

The anti-inflammatory effect of the extract observed may be due to its phytochemical constituents such as tannins and flavonoids. This was reported [23] that plant chemical constituents; tannins, flavonoids and saponins were proven to have anti- inflammatory effects.

Immune steroid anti-inflammatory drugs alter the activities and migration of inflammatory cells responsible for amplifying the inflammatory response [24].

Inflammatory is caused by the released of chemicals tissues and migrating cells. Non –steroidal anti-inflammatory drugs produce their therapeutic activities through inhibition of cyclo-oxygenase (COX), the enzyme that is involved in prostaglandin-biosynthesis. Cox has two isoenzymes (COX-1 and COX-2).

COX-2 induced by inflammatory stimuli such as cytokines, and produced prostaglandins that contribute to the pain and swelling of inflammation.

The glucocorticoids are class of steroids that reduce inflammation by binding to glucocorticoid receptor. The activated glucocorticoid receptor regulates the expression of anti-inflammatory protein in the nucleus and represses the expression of pro-inflammatory protein in the nucleus and represses the expression of pro-inflammatory proteins in the cytosol [25].

Conclusion

From this investigation, the different doses of the extract showed that *sansevieraliberica* leaf possesses significant antioxidant,anti-inflammatory and diuretic properties. The study has shown that the leaves of *Sanseviera liberica* which was used to treat asthma, abdominal pain, colic, diarrhea, eczema, gonorrhea, hemorrhoids, hypertension, menorrhagia, piles, sexual weakness, snake bites and wounds of the foot can also serve as antioxidant, anti-inflammatory and diuretic agents.

The continual search for the interest in natural products used as drugs has acted as the catalyst for exploring methodologies involved in obtaining the required plant materials. I therefore recommend that further studies should be carried out on the plant to isolate active constitutents responsible for its antioxidant, anti-inflammatory and diuretic activities and also explore its exact mechanism of action responsible for its antioxidant, anti-inflammatory and diuretic activities.

Ethical Issues

All animal experiments were in compliance with the National Institute of Health Guide for care and use of laboratory animals (Pub. No. : 85-23, revised 1985). An approval for the use of animals' experimental protocols was secured from the university committee of ethical and appropriate use of animals.

Competing Interests

Authors have declared that no competing interests exist.

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