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Research Article

Exploring the Scientific Basis behind the Therapeutic Efficacy of *Uvaria chamae*: A Major Plus to Alternative Medicine

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Abstract:

Background: From time immemorial, medicinal plants have been used in the treatment and management of diseases, *Uvaria chamae* is such plant. The aim of this study was to unravel and explore the scientific basis of the root extract of the plant behind its effectiveness in ameliorating illnesses using several biochemical and pharmacological assays.

Materials and Methods: *Uvaria chamae* roots were obtained from a local community in Akwa Ibom State of Nigeria. The roots were washed, air-dried, blended and soaked in ethanol for few days, filtered and the filtrate dried in a water bath. The dried sample were divided into portions for phytochemical, proximate and DPPH assays. Acute toxicity test of *Uvaria chamae*'s root was also done to ascertain its safety.

Results: Results obtained from this investigation revealed the presence of several anti-oxidants, ash, carbohydrate, lipid, fibre, protein and energy. The root of *Uvaria chamae* also exhibited strong scavenging reducing capacity using DPPH assay. Acute toxicity test revealed the overall safety of the plant.

Conclusions: The root extract of *Uvaria chamae* possesses strong anti-oxidant capacity, no wonder the rationale behind its use in the treatment and management of a wide range of diseases.

Keywords: uvaria chamae; anti-oxidant; phytochemical analysis; proximate analysis; acute toxicity; DPPH assay

Introduction

Uvaria chamae is a small tree that belongs to Annonaceae family [1]. It is called "Nkanaika ikot" among the Ibibios, "Mmimi ohia" among the igbos, "Kas kaifi" among the Hausas, "Akisan" among the Yorubas and ogholo among the Esan people of Edo state of Nigeria. It has a yellow fruit when ripened and the pulp is widely consumed by locals, the carpels are arranged in a finger-like pattern. The three major parts (root, stem and leaves) of the plant have been reported to have a wide spread medicinal significance. The plant can be used in the treatment of a wide range of diseases including diarrhoea, treatment of cerebral diseases, amenorrhea, piles, hematuria, hemolysis, miscarriage and for the relief of pains during child birth [2]. In West Africa, the plant has been reported to possess febrifugal and purgative abilities. In alternative medicine, combination of the root, leave and stem extracts are used for the treatment of dysentery, vomiting, gastroenteritis, tonsilits, wounds and inflammation [2]. *Uvaria chamae* posesses antibiotic abilities, Oluremi et al. [3] reported the inhibitory capacity of the combined extracts of the root, leaf and stem of the plant on *Escherichia coli*, *Staphylococcus aureus* and *Klebsiella spp*. The antibacterial ability of the plant extracts against many drug resistant bacteria is a crucial breakthrough in the management of drug resistant bacteria. Antibacterial ability of *Uvaria chamae* against wound isolated strains of *Pseudomonas aeruginosa and Proteus mirabilis* was evaluated by Dora et al. [4] using agar cell technique. They reported a greater inhibitory effect of the root extract of *Uvaria chamae* on test isolates and resistance with no inhibitions noticed from *Pseudomonas aeruginosa and Proteus mirabilis*. This antibacterial ability of the plant has attracted more audience in the use of the plant for the prevention and treatment of several inflammatory diseases and diseases associated with cardiovascular system [5,6]. *Uvaria chamae* have been reported to be used in alternative medicine in sickle- cell disease management in West Africa [7]. *Uvaria Chamae* root have been reported to increase peristaltic action on the gastrointestinal tract and could be used as a mild laxative in sickle cell patients to address constipation [8]. Because of its antispasmodic properties, it could be used as a good sedative and could be used to relieve cardiac insufficiency, cough and problems associated with circulation [9]. The anti-ulcer capacity of *Uvaria chamae* was reported by Chilaka et al. [10] who revealed its potent anti-ulcer activity in Wistar rats when compared to a standard anti-ulcer drug, cimetidine, hence the rationale behind the use of the plant in alternative medicine in the management of gastric ulcer. *Uvaria chamae* have been reported to possess anti-venomous activity against snakebite envenomation, this is in support of a folkloric claim that *Uvaria chamae* is used in the treatment and management of snakebite/wounds in Africa. Gabriel et al. [11] reported the use of the plant in the protection against *N. nigricollis* venom-induced lethality in rats which validate the therapeutic rationale of its effectiveness in the management of snake

envenomation. Despite all these scientific reports about the plant, much are still needed to be investigated about the plant, particularly the scientific basis/foundation behind these therapeutic abilities in alternative medicine, hence the rationale for undergoing this study. In this study we, investigated the antioxidant potentials of the root extract of *Uvaria chamae* using proximate and phytochemical analysis (both qualitative and quantitative) as well as its scavenging reducing activity using DPPH assay.

Materials and Methods

Plant Collection and Identification

Uvaria chamae root was obtained from a thick bush in Ikot Efre Itak, a local community in Ikono Local Government Area of Akwa Ibom State, Nigeria. The plant was taken to the Department of Plant Biology and Biotechnology, University of Benin for Identification and authentication by a Plant Biologist. Herbarium number UBH-U353 was assigned to the plant.

Preparation of Plant Extract

The roots were excavated from the soil, washed and cut into sizeable pieces. About 500g of the roots were air-dried for seven (7) days, pulverized with the use of electric blender and macerated in 70% ethanol for 72 hours. The solution was filtered and taken to water bath to dry at 45^0C. Obtained dry matter was sieved and stored in the refrigerator using an air-tight container for further analysis. Different portions of the extract were used for proximate/phytochemical analysis and DPPH assay.

Proximate Analysis: This was done using the method described by [12]

Determination of Moisture

A crucible (empty) was dried in an oven at about 107◦C. The crucible was allowed to cool in a desiccator and weighed, W1 was assigned. The pulverized plant sample (*Uvaria chamae*) was weighed in the crucible and subsequently dried at about 107◦C, W2 was assigned. The crucible with the plant sample (*Uvaria chaemae*) was allowed to cool in a desiccator and the weight measured, W3 was assigned. Moisture content was calculated in percentage as % Moisture content = W2 − W3/ W2 − W1 ×100.

Determination of Total Ash

A heat-resistant crucible was oven-dried for about 10 minutes at 107◦C. It was cooled in a desiccator and the dry weight was taken, W1 was assigned. Afterwhich, the pulverized plant sample (*Uvaria chamae*) was measured in the crucible and reweighed, W2 was assigned. Incineration of the sample was done using a furnace, after which the remaining inorganic material was cooled and weighed, W3 was assigned. Percentage ash content was evaluated as: % Ash content = W3 − W1/ W2 − W1 × 100.

Determination of Crude Fibre

The dried sample of *Uvaria chamae* was weighed in an empty crucible, W1 was assigned. 100ml of neutral detergent solution and 0.5g of sodium sulfite (NA_2SO_3) were added to the crucible, accompanied by few drops of octanol at room temperature. The mixture was boiled for 60 minutes, filtered and the residue was double washed in both boiling water and finally in cold acetone. It was oven-dried at about 107◦C for at least 8hours, cooled in a desiccator and weighed, W2 was assigned. The percentage of the neutral detergent fibre of the sample was calculated as: %CF = (W1 + W2) − W1/ Weight of Sample ×100.

Determination of Total Lipids

A pulverized sample of the plant was measured in a 500ml round bottom flask, with a few grams of anti-bumping granules, W1 was assigned. The lipid content of the pulverized plant sample was extracted in 100ml of diethyl ether at 60 ◦C for 6hour in Soxhlet extractor flask. The filtrate was concentrated, diethyl ether was recovered and the oil in the flask oven-dried. The round bottom flask with the oil was weighed, W2 was assigned. The percentage of crude fat content was calculated thus as: % Crude Lipid = W2 − W1/ Weight of Sample ×100.

Determination of Crude Protein

The pulverized plant sample was weighed in a 30ml Kjeldahl flask and digested with 20ml concentrated tetraoxosulphate (Vi) acid (H_2SO_4). The digest was cooled and diluted with 250ml distilled water and moved into a 50ml Kjeldahl flask with anti-bumping chips and 40ml of 40% sodium hydroxide (NaOH). The distillate from the solution was moved into 25ml of 2% boric acid with a few drops of mixed indicator. 0.01M hydrochloric acid was used to back-titrate the resultant liquid until a violet colour was reached. Percentage protein content was calculated as: % Wp = % Wn_2 × 6.25.

Determination of Carbohydrate

The carbohydrate content was calculated by the difference of the total dry matter and the addition of the percentage ash, crude lipid, crude protein, fibre and moisture using the formula: %C = 100 − (%Ash + %Crude Lipid + %Crude protein + %Fibre +%Moisture).

Determination of Total Energy

Total energy in the sample was calculated in kilojoule per hundred gram and determined by summing up the values for carbohydrate, crude lipid and crude protein using the factors; 16.736 KJ, 37.656KJ and 16.736KJ respectively as shown thus: Energy value (KJ/100g) = (%Crude protein × 16.736) + (%Crude Lipid × 37.656) + (%Carbohydrate × 16.736).

Qualitative Phytochemical Analysis of *Uvaria chamae*:

This was done according to the method described by [13]

Test for Alkaloids

0.5g of the sample (*Uvaria chamae*) was weighed into a 250ml beaker and 200ml of 10% acetic acid in ethanol was added and covered, then allowed to stand for about 4hour. The extract was filtered and concentrated on a waterbath to about one-third of the original volume. Concentrated ammonium hydroxide was added to the extract until precipitation was reached. The solution was allowed to settle and the formation of orange precipitate indicated the presence of alkaloid.

Test for Flavonoids

5-10g of the sample was extracted repeatedly with 100ml of 80% aqueous methanol. The solution was filtered with whatman filter paper (125 mm). The filtrate was moved into a crucible and dried over a water bath and weighed. 1ml of dilute ammonium was added to about 2ml of the filtrate and shaken thoroughly. Formation of a yellow precipitate indicated the presence of flavonoids.

Test for Phenols

Gelatine test: 2ml of 1% solution of gelatine containing 10% of NaCl was added to 5ml of extract. Formation of white precipitate showed the presence of phenols. Lead acetate test: 4ml of 10% lead acetate solution was added and mixed gently with 5 ml of extract. Formation of white precipitate indicated the presence of phenols.

Test for Glycoside

Borntrager's test: 4ml of chloroform was added to 2ml of filtrate and shaken. Appearance of pink colour indicated the presence of glycosides.

Test for Steroid

3ml of chloroform and 2ml of concentrated H_2SO_4 were added to 2ml of extract. Formation of red colour and yellowish green fluorescence indicated the availability of steroids.

Test for Saponin

1mg of extract was immensely shaken with few drop of distilled water. Formation of frothing indicated the presence of saponin. The froth formed was added with few drops of olive oil and shaken thoroughly for the formation of emulsion.

Test for Terpenoid

1ml of chloroform and 1.5ml of concentrated H_2SO_4 were added to 4ml of the extract down the sides of the tube. Appearance of reddish brown colour indicated the availability of terpenoids.

Test for Coumarins

3ml of 10% aqueous solution of NaOH was added to 2ml of the extract. The formation of yellow colour indicated the presence of coumarins.

Test for Phytosterols

The extract was dissolved in 2ml of acetic anhydrite, afterwhich, 2 drops of concentrated H_2SO_4 was added along the side of the tubes. Appearance of cascade of colour change indicated the existence of phytosterols.

Test for Triterpenoids

2ml of concentrated H_2SO_4 was subsequently added accompanied by 1ml of acetic anhydride. Production of reddish violet colour indicated the presence of triterpenoids.

Test for Tannins

Few drops of 5% ferric chloride solution was added to 5ml of the extract. Appearance of dark green colour indicated the presence of tannin.

Test for Phlotannins

The extract was boiled with diluted HCl. Production of reddish precipitate indicated the presence of phlobatannin.

Test for Anthraquinones

Few drops of concentrated H_2SO_4 was added to 5ml of extract followed by 1ml of diluted ammonia. The formation of rose pink indicated the availability of anthraquinones.

Test for Quinones

2ml of alcoholic KOH was added to 1ml of extract. Formation of red to blue colour indicated the presence of quinones.

Quantitative Phytochemical Analysis of *Uvaria chamae*: This was done according to the method described by [13]

Test for Tannin

1g of the extract was added to 40ml of distilled water and stirred for about 45 minutes and filtered. The filtered sample was mixed with 0.2ml of $FeCl_3$ in 0.1M HCl and about 0.006M of $K_4Fe(CN)_6.3H_2O$. Absorbance was measured at about 395nm.

Test for Alkaloid

About 4ml of phosphate buffer was added to 1ml of the extract plus 3ml of BCG solution and shaken vigorously with 3ml of chloroform. Absorbance was measured at about 470nm.

Test for Saponin

80% methanol was used to dissolve the extract, about 1.5ml of vanillin mixed in ethanol was added and shaken. 3ml of 70% sulphuric acid was added and heated using a water bath for 9 minutes. Absorbance was measured at about 544nm.

Test for Phenol

Test extract was mixed with 0.5ml of FCR (Folin-Ciocalteu's reagent) followed by 3ml of sodium carbonate and allowed to stand for 1 hour 30 minutes. Absorbance was measured at about 750nm.

Test for Flavonoid

1.5ml of the extract was mixed with 5ml of water and added to a volumetric flask of about 10ml. 0.3 ml of sodium nitrite and 0.4ml of ammonium chloride were added and incubated for some minutes. 3ml of 1M of sodium hydroxide was added to the solution. Absorbance was measured at about 510nm.

Test for Glycoside

1g of the extract was added to about 200cm^3 of water and allowed to stand for 2hours. 25 cm^3 of NAOH was added to the extract after the addition of tannic acid. 2cm^3 of 5% of potassium iodide was added and absorbance was measured at about 300nm.

Determination of DPPH Radical Reducing Activity: This was done according to the method described by [14]

100mg of sample was taken into centrifuge tube in triplicate. Methanol was used as the blank. 200µl of distilled water was taken in blank (methanol) instead of the sample. 1ml of DPPH solution was added to the sample and the blank. The solution was left at room temperature for 30 minutes. Centrifuge tubes were centrifuged for 10mins at 4000 rpm. 0.7ml of supernatant was poured into fresh tubes containing 1ml of ethanol. Absorbance was read at 517nm using spectrophotometer. The IC_{50} value which is the concentration to scavenge 50% of DPPH radical was calculated using the formular: % inhibition = Abs of blank – Abs of sample/ Abs of blank x100.

Determination of LD_{50} of *Uvaria chamae*: This was done according to the method described by [15]

The animals were divided into 2 phases (phase 1 and phase 2). In the first phase, nine rats were randomly divided into three groups of three rats per group and different doses of the extract (10mg/kg, 100mg/kg and 1000mg/kg) were given via oro-gastric tube respectively. The rats were observed for signs of adverse effects and death for 24hr. In the second phase of the study, the procedure was repeated using three rats randomly divided into three groups of one rat each and were given 1600, 2900 and 5000mg of the extract, respectively. The rats were observed for signs of toxicity and mortality. LD_{50} of the extract was calculated thus using the formular: $LD_{50}= \sqrt{D_0 \times D_{100}}$, where D_0 is the minimum dose that caused death and D_{100} is the maximum dose that did not cause any death.

Results

Proximate Analysis

Proximate analysis of *Uvaria chamae* root extract was evaluated and presented in table **1**. Proximate evaluation showed the presence of moisture, ash, crude fibre, lipids, crude protein, carbohydrate and energy. The moisture content of the plant (10.600±0.000%) was higher than total ash (3.660±0.000%), total lipids (0.86±0.00%) and crude protein (2.650±0.010%). Total ash content signifies an appreciable quantity of mineral elements in the root of *Uvaria chamae*. There was an appreciable quantity of carbohydrate (42.720±0.010%) but higher than the crude fibre content (40.060±0.000%) of the plant. These carbohydrate and fibre contents are good sources of energy and roughages respectively. The high energy content (189.200±0.000KJ) is due to the appreciable quantity of carbohydrate present.

Components	Value
Moisture (%)	10.600± 0.000
Total ash (%)	3.660±0.000
Crude fiber (%)	40.060±0.000
Total lipids (%)	0.860±0.000
Crude protein (%)	2.650±0.010

Carbohydrate (%)	42.720± 0.010
Energy (KJ)	189.200± 0.000

Table 1: Proximate analysis of *Uvaria chamae* Root Extract

Qualitative Phytochemical Analysis

Qualitative preliminary phytochemical screening was evaluated and presented in table **2**. It revealed the presence of alkaloids, flavonoid, phenols, steroid etc.

Phytochemical constituents	Inference
Alkaloids	+++
Flavonoid	+++
Phenols	+++
Glycoside	+
Steroid	+
Saponin	++
Terpenoid	_
Coumarins	++
Phytosterols	+
Diterpenoids	++
Triterpenoids	+++
Amino acid	+++
Tannin	+++
Phlobatannin	_
Anthraquinone	+
Cardiac glycosides	+
Quinone	+++

*- Absent, + present, ++ moderately present, +++ abundantly present

Table 2: Qualitative Phytochemical Analysis of *Uvaria chamae* Root Extract

Quantitative Phytochemical Analysis

Similarly, result of quantitative phytochemical screening was evaluated and presented in table **3**. It revealed the presence of the following compounds with their number of secondary metabolites, tannin (154.100 ± 1.730mg/100g), alkaloid (107.200 ± 0.550mg/100g), saponin (77.570± 1.190mg/100g), Phenolic compounds (177.600 ± 0.750mg/100g), flavonoid (165.900± 0.610mg/100g) and glycoside (10.16±0.01mg/100g). Phenolic compounds (177.600± 0.750mg/100g) were significantly higher than tannin and others.

Parameter	Value (Mean±S.E.M)
Tannin(mg/100g)	154.100 ± 1.730
Alkaloid(mg/100g)	107.200 ± 0.550
Saponin(mg/100g)	77.570 ± 1.190
Phenol(mg/100g)	177.600 ± 0.750
Flavonoid(mg/100g)	165.900 ± 0.610
Glycoside(mg/100g)	10.160 ± 0.010

Table 3: Quantitative Phytochemical Analysis of *Uvaria chamae* Root Extract

Effect of Root Extract of *Uvaria chamae* on DPPH Reducing Radical Activity

The DPPH radical was effectively and strongly scavenged by the root extract of *Uvaria chamae* which revealed the presence of antioxidant potentials. A dose dependent increment was observed within the range of concentrations (0-100 µg/ml) of root extract. The percentage inhibition of scavenging activities of the root extract at a given concentration of 100µg/ml was found to be 32.39%. The percentage inhibition for *Uvaria chamae* sample was concentration dependent up to the given concentration of 100µg/ml. Free radicals were scavenged by the root extract in a concentration dependent manner. Antioxidant capacity of *Uvaria chamae* root depends on the presence of total phenolic compounds. The higher, the concentration, the higher, the percentage of inhibition (Table 4)

S/N	Extract(µg/ml)	Absorbance(nm)	% Inhibition
Blank (0)	0.000	1.451	0.000
1	20.000	1.205	16.950
2	40.000	1.199	17.370
3	60.000	1.164	19.780
4	80.000	1.076	25.840
5	100.000	0.981	32.390

Table 4: Effect of Root Extract of *Uvaria chamae* on DPPH Reducing Radical Activity

LD50 of *Uvaria chamae*

Acute toxicity test result (**LD_{50}**) of root extract *of Uvaria chamae* showed that there was no death at 5000mg/kg body weight within 24 hrs. Ultimately, the root extract of the plant was relatively safe.

Discussion

For many centuries, medicinal plants have been reported to contain substances of therapeutic importance for the treatment of many forms of ailments and diseases [16]. In Nigeria, many people still believe in the usefulness of herbal medicine for treatment of several degrees of diseases. Plants are very useful in the development of drugs. From this current investigation, *Uvaria chamae* has been found to contain various substances of great clinical and medical influences. Proximate evaluation of the root extract of the plant revealed the availability of moisture, ash content, crude fibre, lipids, protein, carbohydrate and energy, this proximate component has great health benefits and useful in traditional medicine and its practice. Proximate components and other environmental factors determined the shelf life of medicinal plants [17]. It has been reported that moisture content of plant materials greater than 15% stands the risk of contamination by bacteria and fungi [18]. Findings from our present investigation showed that the moisture content of root extract of *Uvaria chamae* (10.600± 0.000%) has low moisture content and therefore can be stored or preserved with little or no risk of invasion of microorganisms and insects, thus increasing the plant's shelf life. The ash content of the plant demonstrates the availability of inorganic minerals. These inorganic minerals include calcium, zinc, potassium and mercury. The ash content in the plant was evaluated to be 3.360±0.000%. Generally, minerals have been reported to be useful for the mental and physical wellbeing of an individual [17]. The high fibre content of the plant was estimated to be 40.060±0.000%, fibres are roughages which can promote optimal gut health, reduce the risk of cardiovascular disease and maintain body weight. From our findings, *Uvaria chamae* root is a very good source of roughage. The lipid content of the plant was quantified to be 0.860± 0.000%, lipids have been reported to possess therapeutic capacity in animals by preserving insulin sensitivity [19]. Lipid content of the plant greatly contributes to its medicinal efficacy. Similarly, the protein content of the plant was estimated to be 2.650± 0.010%, proteins function as hormones, enzymes and can be considered as part of blood, skin, muscle and even cartilage. An amino acid (glycine) which is a building block of protein has been reported to be a precursor in the biosynthesis of porphyrins which are precursors of the heme portion of hemoglobin [20]. Nutritionally, about 0.8g/kg body weight of dietary protein intake is recommended daily for humans irrespective of age or sex [21]. The root of *Uvaria chamae* can therefore be recommended as an important source of dietary protein. Carbohydrate composition of the root extract of *Uvaria chamae* was estimated to be 42.720±0.010%, carbohydrate which is in appreciable quantity is another source of energy in food. Studies have shown that diets with low carbohydrate level can reduce the risk of heart diseases as well as controlling diabetes associated with obesity [22]. In this regard, the root of *Uvaria chamae* stands a better chance because it is locally consumed by the locals for many purposes. Total energy of the plant was estimated to be 189.200± 0.000KJ, this high energy level in the plant is traceable to the appreciable quantity of carbohydrate. It can be a very good source of energy to humans, this is because energy is used in the maintenance of the body's essential functions such as cellular growth and repair, respiration, blood transport, enhances physical exercise and recreational activities. Phytochemical investigation and quantitative estimation of the percentage yield of chemical constituents in the plant revealed the presence of alkaloid, flavonoid, phenols etc. These phytochemicals serve as natural occurring antibiotics which help the body in the fight against bacterial and pathogen invasion and are responsible for the medicinal use of *Uvaria chamae* in Africa. Presence of alkaloid in the plant is necessary for the survival and protection of the plant against bacterial and fungal activities. Alkaloid has been reported to possess anti-malarial, anti-hypertensive and anti-cancer effects [23]. The high content of alkaloid in the plant (107.200 ± 0.550mg/100g) clearly showed its ability to ameliorate the inflammatory actions of some heavy metals in many organs of the body as reported by many authors. Psychotropic and stimulant effects of alkaloid have been reported to be useful as recreational drugs [24]. Flavonoids have been reported to have antioxidant effects and have been portrayed to hinder the initiation, promotion and advancement of tumors [25]. Other biological activities of flavonoid include anti-inflammatory, anti-allergic, anti-viral and antibacterial tendencies. Flavonoids interfere with enzymes that produce estrogen, thereby reducing the risk of estrogen-induced cancers. The high presence of flavonoid (165.900 ± 0.610mg/100g) indicated the high antioxidant capacity of the plant with the ability to protect the body against free radicals and oxidative stress. This result is in agreement with Okwu and Iroabuchi [26] who reported a high availability of flavonoids in the root of the plant. Phenolic compounds have also been found to be present in the plant (177.600 ± 0.750mg/100g). Phenols have been indicated to increase secretion of bile, reduce blood levels of cholesterol and lipid, possesses anti-inflamatory, anti-tumour and anti-depressant capacities [27, 28]. This anti-tumour capacity of the plant due to phenol was reported to ameliorate cancer in various organs. Phenols can contract the uterine smooth muscle of a Guinea pig. High dosage of *Uvaria chamae* have been reported to prepare the uterus and reduce fatique thereby producing strong and regular uterine contraction which facilitates parturition, the very reason why it is used in the Eastern part of Nigeria to facilitate labour [29]. Glycoside was found to be present (10.160 ± 0.010mg/100g) in the plant and it has been reported to be used in treatment of congestive heart failure as a result of its direct impact on the force of myocardial contraction [30]. Glycoside also act directly on the smooth muscle of the vascular wall coupled with its impact on the neural tissues and electrical activities of the cardiovascular system [30]. Presence of saponin revealed the protective and ameliorative capacity of the plant, saponin have been reported to be protective, antimicrobial and inhibitive to moulds and invasive attacks. Saponin has anti-carcinogenic effect and has been found to affect growth, reproduction and intake of food in animals. It has antifungal and anti-viral potentials [31]. Presence of coumarins revealed the anti-cancer property of *Uvaria chamae* and they constitute a useful category of pharmacological agents and possess a wide range of physiological abilities. Coumarins possess anti- inflammatory, anti-cancer, anti-coagulant, anti-bacterial and analgesic properties. They are also involved in comparative immune system modulation. Similarly, phytosterols decrease total serum cholesterol level, decrease low density lipoproteins, has anti-inflammatory effect, possesses antioxidant capacity and can offer protection against various forms of cancer such as colon and breast cancers, the anti- carcinogenic potential of the root extract may also be linked to the presence of phytosterols in the plant [32]. Dipertenoids, triterpenoids, amino acid, anthraquinone and quinone were evaluated to be present in the plant, diterpenoids possesses anti-inflammatory, antimicrobial, anti-tumour activities and immune-modulatory activities. Triterpenoids have been reported to have antiviral, antibacterial, antioxidation, antihypertensive and anti-tumor potentials, moreso, it can exhibit cell death (apoptosis), cell cytotoxicity, cell cycle arrest and anti-invasion properties. Amino acid is the building block of proteins which are useful in driving metabolic reactions, maintaining hydrogen ion concentration and fluid balance, guarding the immune system and repairing body tissues. Anthraquinones have been reported to be used as laxatives, used to reduce constipation, arthritis and multiple sclerosis. It has a strong anti- cancer capacity. Quinones are significant in blood coagulation; they function as cofactors in the electron transport system and useful in cellular respiration. Availability of these bioactive compounds signify why the root of *Uvaria chamae* is used in the treatment of various degrees of diseases. The root extract of *Uvaria chamae* was able to decrease DPPH stable free radicals. This is an indication that the root extract possesses many bioactive components that are capable of removing odd electrons by donating hydrogen to a free radical. Scavenging activity of the root of *Uvaria chamae* indicated a decrease in DPPH concentration. The results so far revealed a significant correlation and relationship between the root extract of *Uvaria chamae* and the percentage of inhibition of free radicals. The scavenging activity of the plant was concentration based and could be due to the existence of phenolic compounds and others. This result is in line with previous results obtained

using DPPH assay to evaluate the antioxidant capacity of various plants. DPPH was used to evaluate the antioxidant ability of phenol in the plant and the result brought to light, the high content of phenol (177.600 ± 0.750mg/100g) in the plant when compared to other bioactive ingredients. Result obtained from acute toxicity studies showed that the root extract of *Uvaria chamae* was relatively safe with an oral LD_{50} of 5000mg/kg which is in conformity with the results published by Eugenia [33] concerning the relative safety of *Uvaria chamae* at LD_{50} > 2500mg/kg. The use of LD_{50} has become useful to determine the general toxicity of a chemical compound or plant extract [34]. It evaluates the adverse impacts following the exposure of animals to either a single of multiple doses of a substance or test agent under investigation within 24 hours via oral, inhalation or intraperitoneal routes [35]. Absorption of these administered agents elicit adverse effects thereby resulting in fatality. Results from LD_{50} test serve as a guide in selecting dosages. The root extract of the plant is safe due to the absence of toxic metabolites as one of its constituents.

Conclusion

The root extract of *Uvaria chamae* possesses strong anti-oxidant potentials, no wonder the rationale behind its use in the treatment and management of a wide range of diseases.

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Conflict of interest

Authors have declared that there is no existing conflict of interest.

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