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Evaluation of Phytochemical Content and Antioxidant Potential of *Ocimum gratissimum* and *Telfairia occidentalis* Leaves

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Authors' Contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Aim: The aim of this study is to compare the phytochemical content and antioxidant potential of *Ocimum gratissimum* and *Telfairia occidentalis* leaves.
Study Design: This study was made to fit a one-way Analysis of Variance.
Place and Duration of Study: This research was carried out in the Department of Premedical Science, Educational Advancement Centre, Ibadan and Pharmaceutical Laboratory of the University of Ibadan, Nigeria between January and June, 2018.
Methods: Both plants were purchased from Bodija market in Ibadan, Nigeria. The leaves were

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removed from the stem and washed with running water to remove contaminants. It was oven dried at 37˚C and milled into powder and extracted with ethanol. The qualitative and quantitative analyses of the phytochemical content as well as antioxidant potential were investigated.

Results: The result showed that *O. gratissimum* is significantly higher in flavonoids content but lower in alkaloids when compared with those of *T. occidentalis* at $P<0.05$. No significant difference was observed in the concentrations of saponin, tannin, total phenolics and phytic acid in *O. gratissimum* when compared with those of *T. occidentalis* respectively at $P<0.05$. Antioxidant investigation showed that *O. gratissimum* is higher in ferric-ion reducing power but lower in ascorbic acid when compared with *T. occidentalis* respectively at $P<0.05$. The percentage inhibition of 2,2-diphenyl-1-picryl-hydrazyl-hydrate radical scavenging potential was observed to decrease with decreasing concentration for both plants but that of *O. gratissimum* was lower when compared with that of *T. occidentalis* respectively.

Conclusion: This pharmacological study is a useful tool for further drug development from the natural plant products.

Keywords: Phytochemical content; antioxidant potential; Ocimum gratissimum; Telfairia occidentalis.

1. INTRODUCTION

Ocimum gratissimum L. is an herbaceous plant which belongs to the Labiatae family. It is commonly referred to as scent leave. The plant is indigenous to tropical areas especially India and it is also in West Africa. In Nigeria, it is found in the Savannah and coastal areas. It is cultivated in Ceylon, South Sea Islands, and also within Nepal, Bengal, Chittagong and Deccan [1]. It is known by various names in different parts of the world. In India it is known by its several vernacular names, the most commonly used ones being Vriddhutulsi (Sanskrit), Ram tulsi (Hindi), Nimma tulasi (Kannada). In Nigeria, the plant is called “effinrin-nla” by the Yorubas, “Ahuji” or “Nchuanwu” by the Igbos, “Daidoya” by the Hausas [2]. *O. gratissimum* has been reported to have immense health benefits such as treatment of diarrhea, chronic dysentery and vomiting. It is used in treatment of oral infection, fungal infections, fever, cold and catarrh (this spelling is correct) [2]. It is also used for the prevention and treatment of malaria, ear ache and colon pains [3]. It can be used for the treatment of urinary infections, gonorrhea infection, vaginal douches for vaginitis [4].

Telfairia occidentalis Hook. f. (Fluted pumpkin) is one of the popular and widely grown vegetable crops in Nigeria particularly in the eastern part (Anambra, Imo, Enugu, Abia and Ebonyi States) and mid-western areas (Edo, and Delta States) and to an appreciable degree in the south western states (Ondo, Ogun, Osun, Ekiti, Oyo and Lagos). It is often referred to as “ugu” [5]. It is a pot-herb cultivated mainly for its succulent young leaves and shoots which are used as vegetables [6]. It is a high-climbing perennial with partial drought tolerance and parenting root system. The crop is grown close to trees, walls, fences and structures on which the shoots are allowed to climb. It could be allowed to creep on the ground or staked [7]. *T. occidentalis* has some health benefit. It is useful in the management of cholesterolemia, liver problems. It prevents malaria, microbial infection, it is also used to boost blood level and treat diabetes [8].

1.1 Phytochemicals

Phytochemicals are biologically active, naturally occurring chemical compounds found in plants, which provide health benefits for humans further than those attributed to macronutrients and micronutrients [9]. They protect plants from disease and damage and contribute to the plant’s colour, aroma and flavour. In general, the plant chemicals that protect plant cells from environmental hazards such as pollution, stress, drought, ultraviolet exposure and pathogenic attack are called phytochemicals [10]. Dietary phytochemicals are found in fruits, vegetables, legumes, whole grains, nuts, seeds, fungi, herbs and spices [10]. Broccoli, cabbage, carrots, onions, garlic, whole wheat bread, tomatoes, grapes, cherries, strawberries, raspberries, beans, legumes, and soy foods are common sources [11]. Phytochemicals can be found in different parts of the plants, such as the leaves, flowers, roots, stems, seeds and fruits. Phytochemical concentration varies from plant to plant depending on the variety, growth conditions, season etc. These compounds are plants secondary metabolites. Plants produce these chemicals to protect themselves but it has been discovered that they can also protect humans against diseases [12]. They include:

1.1.1 Saponin

The term saponin is derived from *Saponaria vaccaria*L. (Syn:Quillaja saponaria), a plant, which abounds in saponins and was once used as soap. Saponins produce foam and therefore possess ‘soaplike’ behaviour in water. When hydrolysed, an aglycone is produced, which is called sapogenin, hence, they are often referred to as foaming glycosides [13]. They possess a bitter and acrid taste, besides causing irritation to mucous membranes. Saponins are also important therapeutically as they have been reported to possess hypolipidemic and anticancer activity [14]. They are also important in activity of cardiac glycosides [13]. Steroidal saponins are used in the commercial production of sex hormones for clinical use [14].

1.1.2 Tannins

These are widely distributed in plant flora. They are phenolic compounds of high molecular weight. Tannins are soluble in water and alcohol and are found in the root, bark, stem and outer layers of plant tissue. They have a characteristic feature to tan, i.e. to convert things into leather. They are acidic in reaction and the acidic reaction is attributed to the presence of phenolics or carboxylic group [13]. They form complexes with proteins, carbohydrates, gelatin and alkaloids. Tannins are used as antiseptic and this activity is due to the presence of phenolic group. Tannin-rich medicinal plants are used as healing agents in a number of diseases. In Ayurveda, formulations based on tannin-rich plants have been used for the treatment of diseases like leucorrhoea, rhinnorhoea and diarrhea [15].

1.1.3 Phytic acid

This is also known as inositol hexa-kisphosphate (IP6), or phytate when in salt form. It is the principal storage form of phosphorus in many plant tissues [16]. Among all the anti-nutritional components, phytic acid is of prime concern for human nutrition and health management. The unique structure of phytic acid offers it the ability to strongly chelate with cations such as calcium, magnesium, zinc, copper, iron and potassium to form insoluble salts. It therefore adversely affects the absorption and digestion of these minerals by animals [13]. Besides, phytate has also been reported to form complexes with proteins at both low and high pH values. These complex formations alter the protein structure, which may result in decreased protein solubility, enzymatic activity and proteolytic digestibility [15]. In spite of many negative aspects on human health, the consumption of phytate, however, has been reported to have some favourable effects. The outcome of surveillance of populations consuming vegetarian-type diets has shown lower incidence of cancer, which suggests that phytate has an anticarcinogen effect [17]. The metal binding characteristics of phytate endow it an anti-oxidant function, inhibiting the production of hydroxyl radicals that normalise cell homeostasis and it also acts as a natural food antioxidant [13]. Dietary phytate may have health benefits for diabetes patients because it lowers the blood glucose response by reducing the rate of starch digestion and slowing gastric emptying [18]. Likewise, phytate has also been shown to regulate insulin secretion. It is believed that phytate reduces blood clots, cholesterol and triglycerides and thus prevents heart diseases. It is also suggested that it prevents renal stone development. It is used as a complexing agent for removal of traces of heavy metal ions. *In vitro* studies have indicated that phytic acid incubated with HIV-1 infected T cells inhibits the replication of HIV-1 [19].

1.1.4 Alkaloids

Alkaloids are natural products that contain heterocyclic nitrogen atoms. They are basic in character. They are also secondary metabolites in plants and serve a number of functions in plants such as protective agents against micro-organisms (antibacterial and antifungal activities), and are important to humans in a number of ways [20]. They are used in medicine as pain killers: Quidinine, a type of alkaloid is used to treat fibrillation (irregular contraction of the heart). Vinblastine is used as an anti-tumor agent. Quinine is used as an anti-malarial agent. Previous studies have shown that plant-derived alkaloids have great potential for anti-malaria drug development. A number of alkaloids have been successfully used for the treatment of parasitic infection [20].

1.1.5 Phenolics

Phenolic phytochemicals are the largest group of phytochemicals and the most widely distributed in plants. The three major groups of dietary phenolics are flavonoids, phenolic acids, and polyphenols. Phenolic are hydroxyl group (-OH) containing class of chemical compounds where the (-OH) bonded directly to an aromatic hydrocarbon group. Phenol (C_6H_5OH) is considered the simplest class of this group of natural compounds. Phenolic compounds are a large and complex group of chemical constituents found in plants [10]. They are plant secondary metabolites, and they have an important role as defense compounds. Phenolics exhibit several properties beneficial to humans and its antioxidant properties are important in determining their role as protecting agents against free radical-mediated disease processes [14].

1.1.6 Flavonoids

Flavonoids make up the largest class of phytochemicals [21]. In general, flavonoids can play an important role in decreasing disease risk through various physiologic mechanisms. Some of these include antiviral, anti-inflammatory, cytotoxic, antimicrobial, and antioxidant effects. Mechanisms responsible for improvements in heart disease risk include improved endothelial function, decreased blood pressure, and improvements in lipid and insulin resistance. Flavonoids can be divided into the following subclasses flavonols, flavanones, flavones, flavan-3-ols, and flavanonols [22]. Koosha *et al*. [22] reported relationship between flavonoid consumption and decreased cancer risk.

1.2 Antioxidants

Antioxidants protect cells against the damaging effects of reactive oxygen species otherwise called, free radicals such as singlet oxygen, super oxide radicals, peroxyl radicals, hydroxyl radicals and peroxynitrite which results in oxidative stress leading to cellular damage [23]. Natural antioxidants play a key role in health maintenance and prevention of the chronic and degenerative diseases, such as atherosclerosis, cardiac and cerebral ischema, carcinogenesis, neurodegenerative disorders, diabetic pregnancy, rheumatic disorder, DNA damage and ageing [24]. Antioxidants exert their activity by scavenging the ‘free-oxygen radicals’ thereby giving rise to a fairly ‘stable radical’. The free radicals are metastable chemical species, which tend to trap electrons from the molecules in the immediate surroundings. These radicals if not scavenged effectively, they may damage crucial biomolecules like lipids, proteins including those present in membranes, mitochondria and DNA resulting in abnormalities leading to disease conditions [24]. Free radicals generated in the body can be removed by the body’s own natural antioxidant defenses such as glutathione or catalases. Therefore, this deficiency had to be compensated by making use of natural exogenous antioxidants, such as vitamin C, vitamin E, flavones, B-carotene and natural products in plants [24,25].

2. METHODOLOGY

2.1 Plant Preparation

O. gratissimum and *T. occidentalis* were freshly purchased from Bodija market, Ibadan, Nigeria and were identified by a botanist, Mr. O. A. Adekale. The leaves were removed from the stem, washed and dried in the oven at a temperature of 37˚C to remove moisture. The dried leaves were milled into powder by blending to increase the surface area for extraction.

2.2 Method of Extraction

The powdered leaves were extracted by soaking for 72 hours in enclosed glass jars (desiccators) using the cold method of extraction. Solvent used for both powdered leaves was 75% ethanol. The solvent was evaporated using rotary evaporator at 37˚C.

2.3 Qualitative Analyses of Phytochemicals

Qualitative determination of alkaloid, saponin, tannin, flavonoid, Phenol, steroids, anthraxquinone glycosides, were carried out by the methods described by Chandrashekar et al. [26], Carbohydrate was determined qualitatively by using Molisch’s test [27], protein was carried out using Xanthoproteic test [27], anthocyanin, Coumarin, Emodins, phlobatannins were determined by the method described by Ashvin et al. [27], while terpenoid was determined qualitatively by using Salkowski’s test [28].

2.4 Quantitative Analyses of Phytochemicals

Among the phytochemicals determined qualitatively, six present in both plants were analyzed quantitatively in triplicate. Saponin determination was carried out quantitatively by the method of Obadoni and Ochuko [29], tannins were determined by Folin-Ciocalteu method [30], The concentration of total phenolics was determined spectrophotometrically, alkaloids and phytate were carried out by the method of Harborne [31], flavonoid was carried out by the method of Bohm and Kocipai-Abyazan [32].

2.5 Determination of Antioxidant

Ferric-Ion Reducing Antioxidant Power (FRAP) was determined in triplicate by assessing the ability of the extract to reduce $FeCl_3$ solution as described by Oyaizu [33], concentration of ascorbic acid was determined in triplicate by the iodimetry method [34], The antioxidant activity was measured in triplicate in terms of hydrogen donating or radical scavenging ability using the 2,2-Diphenyl-1-Picrylhydrazyl (DPPH) Radical Scavenging Method [35].

2.6 Statistical Analysis

Data were subjected to analysis using Graph Pad Prism, version 6.0. Results were presented as mean $\pm$ standard deviations. One way Analysis of Variance (ANOVA)followed by Tukey Kramer was used for comparison of the mean. Differences between means were considered to be significant at p<0.05 (95% confidence level).

3. RESULTS AND DISCUSSION

Phytochemicals are chemical compounds produced by plants, generally to help thrive or

Table 1. Qualitative analysis of phytochemical content of *O. gratissimum* and *T. occidentalis* leaves

Phytochemicals	*O. gratissimum*	*T. occidentalis*
Alkaloid (Hager's Test)	+	+
Saponin (Foam Test)	+	+
Anthraquinone (Borntrager's Test)	-	-
Tannin (Braymer's Test)	+	+
Phlobatannin (Precipitate test)	+	+
Anthocyanins	-	-
Terpenoid	-	-
Flavonoid	+	+
Phenols	+	+
Emodin	-	-
Coumarin	+	+
Glycosides (Liebermann's Test)	-	-
Steroid (Salkowaski Test)	-	-
Carbohydrate (Molisch's Test)	-	-
Protein (Xanthoproteic Test)	-	-

+ means present, – means absent

Table 2. Concentrations of phytochemicals in both plants

Phytochemicals	*O. gratissimum*	*T. occidentalis*
Saponin (%)	0.016 ± 0.005^{a}	0.013 ± 0.011^{b}
Tannins (mg/g)	10.2 ± 0.2^{a}	9.33 ± 0.07^{a}
Total Phenolics (mg/g)	5.86 ± 0.12^{a}	7.71 ± 0.2^{a}
Alkaloids (%)	0.0313 ± 0.03^{a}	0.023 ± 0.02^{a}
Flavonoid (%)	0.034 ± 0.012^{a}	0.03 ± 0.01^{b}
Phytic Acid (%)	0.811 ± 0.109^{a}	0.824 ± 0.098^{a}

Results are presented as mean ± standard deviation where n=3. Values with different superscript along the same row are said to be significant at p<0.05 when both plants were compared

Table 3. Concentrations of ascorbic acid and ferric-ion reducing antioxidant power

Antioxidant	*O. gratissimum*	*T. occidentalis*
Ascorbic Acid (mg/g)	22.02 ± 0.01^{a}	26.42 ± 3.43^{b}
FRAP (mg/g)	411.08 ± 3.82^{a}	265.25 ± 1.44^{b}

Results are presented as mean ± standard deviation where n=3. Values with different superscript along the same row are said to be significant at p<0.05when both plants were compared. FRAP = Ferric-ion Reducing Antioxidant Power

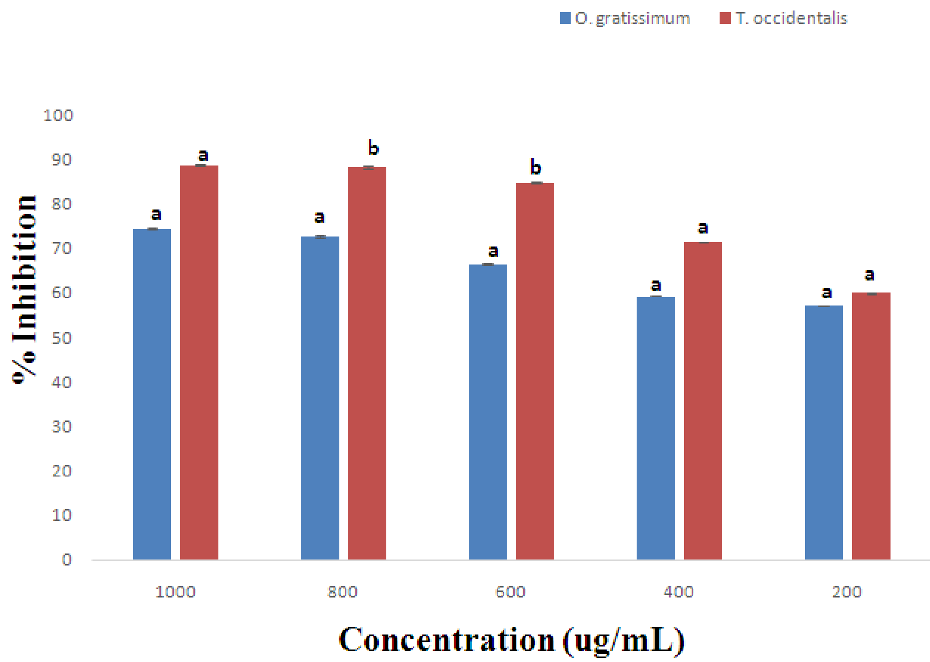

Fig. 1. α, α-diphenyl-β-picrylhydrazyl (DPPH) Radical Scavenging potential of *O. gratissimum* and *T. occidentalis* respectively at different concentrations. The result is presented as mean ± standard deviation with n = 3. Bars of the same concentration with different letters are significantly different at *P<0.05* when both plants were compared

thwart competitors, predators or pathogens. The phytochemical category includes compounds recognized as essential nutrients, which are naturally contained in plants and are required for normal physiological functions and must be obtained from diet by humans [36]. Phytochemicals are bioactive compounds found in vegetables, fruits, cereal grains, and plant based beverages such as tea and wine. They are chemicals produced by plants through primary or secondary metabolism. They have been used as poison and in tradition medicine [37].

The result of the quantitative analysis of phytochemical content of both plants investigated in this study is presented in Table 2.It was observed that the concentration of saponin was insignificantly higher in *T. occidentalis* when compared with that of *O. gratissimum* at *P<0.05*. It has been reported that saponin has a range of biological activities and potential health benefits such as hypocholesterolemic, anti-coagulant, anti-carcinogenic, hepatoprotective, hypo-glycemic, immunomodulatory, neuroprotective, anti-inflammatory, anti-oxidant activity, inhibition of dental caries and platelet aggregation [38]. They might also be used in the treatment of hypercalciuria and have also been found to significantly affect growth positively, feed intake and reproduction in animals. Saponins have also been observed to kill protozoans and molluscs and act as antifungal and antiviral agents [39]. This implies that *T. occidentalis* might have higher potential in fighting against microorganisms such as fungi and viruses, as well as exhibits greater antioxidant activity and prevents liver damage than *O. gratissimum*.

It was observed in this study, that the concentration of alkaloids had no significant difference when *O. gratissimum* was compared with that of *T. occidentalis* at *P<0.05*. Alkaloids have many pharmacological activities including antihypertensive effects (many indole alkaloids), antiarrhythmic effect (quinidine, spareien), antimalarial activity (quinine), and anticancer actions (dimeric indoles, vincristine, vinblastine). Some alkaloids have stimulant properties such as caffeine, nicotine and morphine and are used as analgesic [40]. This implies that *T. occidentalis* might have greater potential in preventing malaria, hypertension, cancer and cough (codeine) than *O. gratissimum.*

It was observed in this study, that the concentration of flavonoid was significantly higher in *O. gratissimum* when compared with that of *T. occidentalis* at *P<0.05*. Flavonoids have been reported to exert multiple biological properties such as antimicrobial, cytotoxicity, anti-inflammatory as well as antitumor activities but the best-described property of almost every group of flavonoids is their capacity to act as antioxidants which can protect the human body from free radicals. The capacity of flavonoids to act as antioxidants depends upon their molecular structure. The position of hydroxyl groups and other features in the chemical structure of flavonoids are important for their antioxidant and free radical scavenging activities. Flavonoids have been stated to possess many useful properties, containing anti-inflammatory activity, enzyme inhibition, antimicrobial activity, oestrogenic activity, anti-allergic activity, antioxidant activity, vascular activity and cytotoxic antitumor activity [41]. Flavonoids constitute a wide range of substances that play important role in protecting biological systems against the harmful effects of oxidative processes on macromolecules, such as carbohydrates, proteins, lipids and DNA [42]. Several studies have reported the potential of some plants extracts to prevent peptic ulcer due to the presence of flavonoid [43,44,45]. This implies that *O. gratissimum* might have higher potential in fighting against free radicals, microbacteria and in preventing harmful damage of DNA (which could lead to aging), lipids (which causes lipid peroxidation), protein (which could lead to mutation), and it can also prevent allergies, inflammatory activity when compared with *T. occidentalis.*

In this study, no significant difference was observed when the tannin content of *O. gratissimum* was compared with that of *T. occidentalis* at *P<0.05*. In medicine, especially in Asia (Japanese and Chinese) tannin-containing plant extracts are used as astringents, against diarrhoea, as diuretics, against stomach and duodenal tumors, and as anti-inflammatory, antiseptic, antioxidant and hemostatic pharmaceuticals [46]. This implies that both plants might have high potential in natural healing and prevention of inflammation.

Similarly, no significant difference was observed when the total phenols content of *O. gratissimum* was compared with that of *T. occidentalis* at *P<0.05*. Varied biological activities of phenolic acids have been reported [38,47,48]. Increase in bile secretion, reduction in blood cholesterol and lipid levels and antimicrobial activity against some strains of bacteria such as staphylococcus aureus are some of biological activities of phenolic acids. Phenolic acid possesses diverse biological activities, such as antiulcer, anti-inflammatory, antioxidant [47], cytotoxic and antitumor, antispasmodic, and antidepressant activities [48]. This implies that *O. gratissimum* and *T. occidentalis* might have a high potential in reducing the cause of arteriosclerosis, prevent ulcer, oxidative stress and tumor formation.

In the same vein, no significant difference was observed when the phytic acid content of *O. gratissimum* was compared with that of *T. occidentalis* at *P<0.05*. Phytic acid has been reported to reduce inflammation and also to inhibit platelet aggregation [38,49]. It is believed that the presence of antioxidants in the pigment of red wine reduces the prevalence of heart disease among red wine users which may support the use of phytic acid, a physiological antioxidant, in the reduction of heart disease. The successful use of phytic acid as an antioxidant includes its ability to chelate iron and remove it from circulation and in the process, block the generation of iron-driven hydroxyl radical as well as the suppression of lipid peroxidation [50]. It has also been suggested that phytic acid may directly bind some enzymes in the process and alter the activities of those enzymes. Phytic acid has also been reported to aid in the control of Type II diabetes by decreasing insulin resistance in the affected patients [51]. This implies that both *O. gratissimum* and *T. occidentalis* might be potent in the reduction of heart diseases, production of antioxidant, prevention of lipid peroxidation, reduction of inflammation and inhibition of platelet aggregation.

Apart from phytochemical content, this study also investigated the antioxidant potentials of *O. gratissimum* and *T. occidentalis*. Antioxidants fulfill several roles in maintaining cellular homeostasis; they donate hydrogen atoms, scavenge free radicals, chelate metal ions, and function as chain breakers in the lipid peroxidation cycle [39]. Antioxidants are either synthesized endogenously in the body, like glutathione and alpha lipoic acid, or obtained exogenously from the diet, like vitamins C, E, and A. Antioxidants are critical in protecting the body from oxidative stress by neutralizing and removing free radicals.

The result of antioxidant potentials of both plants investigated in this study is presented in Table 3 and Fig. 1. The percentage inhibition of 2,2-diphenyl-1-picryl-hydrazyl-hydrate (DPPH) radical scavenging potential was observed to decrease with decreasing concentration for both plants but that of *O. gratissimum* (74.54%, 72.68%, 66.47%, 59.27%, 57.20 %) was lower when compared with that of *T. occidentalis* (88.73%, 88.23%, 84.73%, 71.46%, 59.98%) respectively. DPPH has been reported to have antioxidant which scavenge free radicals and prevent stress. Due to the antioxidant activity, DPPH fight against chronic diseases caused by oxidative diseases. It prevents various degenerative disorders like mutagenesis, carcinogenesis and cardiovascular disturbances [38, 52]. It also prevents proteins, lipids and DNA from damaging. This implies that *T. occidentalis* might have greater potential in preventing lipid peroxidation, aging, mutation, and diseases from occurring than *O. gratissimum*.

The result also showed a significant decrease in the ascorbic acid content of *O. gratissimum* when compared with that of *T. occidentalis* at *P<0.05*. Ascorbic acid, commonly known as vitamin C plays significant roles in the human body, though its function at the cellular level is not very clear. Vitamin C is needed for collagen synthesis, the protein that serves so many connective functions in the body. Among the body's collagen-containing materials and structure are the framework of bone, gums and binding materials in skin muscle or scar tissue. Production of certain hormones and of neurotransmitters and the metabolism of some amino acids and vitamins require vitamin C. This vitamin also helps the liver in the detoxification of toxic substances in the system, and the blood in fighting infections [38]. Ascorbic acid is important in the proper functioning of the immune system. As an antioxidant, it reacts with compounds like histamines and peroxides to reduce inflammatory symptoms. Its antioxidant property is associated with the reduction of cancer incidences [53]. This implies that *T. occidentalis* might have greater potential in fighting infection, reduces inflammatory symptoms, produces certain hormones and collagen and also contains antioxidant properties.

It was observed in this study that the concentration of ferric-ion reducing antioxidant power (FRAP) was significantly higher in *O. gratissimum* (411.08%) when compared to that of *T. occidentalis* (264.41%) at *P<0.05*. FRAP has been reported to contain antioxidants, scavenging free cation radicals as well as reducing oxidants (ferric ions) and prevent diseases. Due to the presence of antioxidant properties in FRAP, it reduces the risk of developing some chronic diseases, including several types of cancer, cardiovascular diseases, diabetes and other degenerative or age-related diseases [54,55]. FRAP assay has many advantages over radical scavenging assays such as excellent reproducibility, linearity over a wide range and high sensitivity. In contrast, the FRAP assay measures the reducing capability by increased sample absorbance and the assay may not complete even several hours after the reaction starts, such that a single end point of the reaction cannot be determined [56]. FRAP assay measures the reducing potential of an antioxidant reacting with a ferric tripyridyltriazine (Fe^{3+}-TPTZ) complex and producing a coloured ferrous tripyridyltriazine (Fe^{2+}-TPTZ). Generally, the reducing properties are associated with the presence of compounds which exert their action by breaking the free radical chain by donating a hydrogen atom [57]. FRAP assay treats the antioxidants in the sample as a reductant in a redox- linked colorimetric reaction. This implies that *O. gratissimum* might have greater potential in reducing ferric-ions than *T. occidentalis*.

An inverse correlation was observed between the ascorbic acid content and FRAP activity. *O. gratissimum* had lower ascorbic acid content but with higher FRAP activity when compared with those of *T. occidentalis*. This is in agreement with the report of Airaodion et al. [38] who studied the comparative assessment of phytochemical content and antioxidant potential of *Azadirachta indica* and *Parquetina nigrescens* leaves.

4. CONCLUSION

In this study, the presence of high phytochemical content and antioxidant potential in *O. gratissimum* and *T. occidentalis* make them potent medicinal plants. These phytochemicals and antioxidants help in the scavenging of free radicals, and exhibit anti-inflammatory, anti-malaria, anti-carcinogenic, anti-ulcerogenic, anti-heamolytic activities, etc. They have also been reported to be potent in the treatment of diseases such as cardiovascular diseases and liver damage. Hence, both plants might serve as remedy for these diseases but *T. occidentalis* might be more effective in carrying out these functions than *O. gratissimum*. This pharmacological study is a useful tool for further drug development from the natural plant products.

CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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