Comparative Studies of the Antioxidant and Phytochemical Activities of Three Traditional Plant Species Used Medicinally in Nigeria.

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ABSTRACT

Background*: Oxidative stress by reactive oxygen species is an antecedent of cardiovascular disease, cancer, diabetics, Alzheimer's disease and osteoporosis. It is of note that plant and plant based materials could serve as antioxidant.*

Objective*: to investigate the presence of important phytochemicals and antioxidants potential of Synclisia scabrida, Persea americana and Picralima nitida and compare the antioxidant prowess of each plant against the other.*

Methods*: Parts of the plants (such as leave, stem, root and seed) were washed, pulverized and extracted with methanol; an assay of the phytochemical constituent of the extracts was also carried out. An in vitro study of radical scavenging activity using the ABTS (2, 2'-azino-bis (3-ethylbenzothiazoline-6-sulfonic acid), 2,2-diphenyl-1-picrylhydrazyl (DPPH) and ferrous reduction assays was used to assay the antioxidant properties of the plants.*

Results*: The phytochemical analysis of the plants revealed the presence of Phenol, Flavonoids, Alkaloids and Saponin. From the study, the methanolic extract of Synclisia scabrida leaves analyzed, showed better antioxidant prowess compared to Persea americana and Picralima nitida leaves, stem and root extracts.*

Conclusion*: Synclisia scabrida is promising in the area of antioxidant drug discovering, nutraceuticals and functional food due to its high antioxidant potential compared to Persea americana and Picralima nitida.*

Keywords: Antioxidant, Phytochemicals, *Perseaamericana*, *Picralimanitida*, and *Synclisia scabrida*

INTRODUCTION

Reactive oxygen species (ROS) are products of oxygen metabolism such as mitochondria and xanthine oxidase, nitric oxide synthase, NADPH oxidase, macrophages and neutrophils; with myoglobin and reperfusion damage being sources of excess ROS production [1-3]. They have beneficial physiological impact which include: non-enzymatic oxidation of unsaturated fatty acid; ability to trigger stem cell differentiation and proliferation; perquisite for normal movement in skeletal muscles under basal conditions, play role in cell signaling transduction, activates cell signaling cascades, apoptosis and gene expression amidst others [4,5]. However, continuous detoxification is vital to provide equilibrium between production and removal of ROS; when this is wanting, oxidative stress occurs [5].

Oxidative stresses by ROS spear-heads

cardiovascular disease, cancer, diabetics, Alzheimer's disease, and osteoporosis. Epidemiological studies and meta-analysis have proposed that long-term intake of plant polyphenols have protective ability against these diseases due to its antioxidant potentials, [6] as against synthetic antioxidant which have been reported to be toxic. Dietary sources such as fruits and vegetables and some beverages are chief sources that are rich in antioxidants, providing elements for synthesis of antioxidant enzymes. Exploration of fruit and vegetables for antioxidant abilities is essential in finding new antioxidant sources to be incorporated in the diet of man. In this study, we attempt to explore the phytochemical potential of three (3) plants species which are *Persea americana, Picralima nitida* and *Synclisia scabrida*. Also to compare the three (3) plants species on their antioxidant potential.

Persea americana ubiquitously called Avocado is a fruit of the tropics, it has all essential amino acids and its oil is used in the food, cosmetics and non-food industries with its by-products having high potentials [7,8]. Fruit extract of this plant has been applied in treating Diabetics Mellitus [9].The peel extract have demonstrated antifungal properties[10]. The seed and its by-products, although toxic in its raw form due to the presence of phytates, oxalates and cyanogenic glycosides has displayed antimicrobial properties when its extract was used[11-13]. Its leave, fruit, seed and oils are reported as potent antioxidants [8, 13, 14].

Picralima nitida is of the family Apocynaceae and is extensively distributed in deciduous forest of Central Africa; [15] it is a shrub with characteristic white latex in all its part with its seed being the most important part of the plant [16]. Ethno-botanically *Picralima nitida* is widely used in treating ailments such as anaemia, gastro-intestinal disorders, hernia, paludism, typhoid fever, jaundice, hypertension, convulsion and this can be attributed to its pharmacological properties [16,17]. Pharmacological report of this plant includes as an anti-inflammatory, antimicrobial, analgesic, hepatoprotective, antitumorigenic, antidiarrheal, hypoglyceamic, antiplasmodia, hypotensive, antiulcer agent [18-20].It's been reported that seed extract has been used to treat cough, displayed antibacterial properties and are potent inhibitors of α-amylase and α-glucosidase enzymes in diabetics [19,21].
Synclisia scabrida of the family Menispermaceae is a dioecious liana occurring in the rain forest. It is distributed from Nigeria to the Central African Republic to DR Congo and Angola. Ethanobotanically, the root is used to treat prostate problems, asthma and hernia, calm patients with mental maladies, treat malaria and gastric ulcer [22]. It has been used in experimental studies to treat peptic ulcer and served as an antibacterial, anticoagulant and antipsychotic agent [23-25].

The three (3) plants highlighted above have been used and prescribed by traditional healers in Nigeria to cure some oxidative ailment; some of their claims need to be corroborated through scientific research. Though there is paucity of information on the investigation of the antioxidant prowess of *Persea americana, Picralima nitida* and *Synclisia scabrida* in literature, however, the antioxidant potential of the different parts of the trio is yet to be compared to enable one make the best of choice in their utilization; this prompted us to initiate this current study which is aimed at analyzing the phytochemicals, investigating and comparing the *in vitro* antioxidant prowess of the methanolic extracts preparation of the different parts (leaves, stems, roots and seed) from these three traditional plant species used medicinally in Nigeria.

Materials and Methods

Preparation of Plants Extracts

Fresh leaves, stems and roots of *Persea americana*, *Picralima nitida* and *Synclisia scabrida* were washed, chopped, air dried and pulverized. 450g of the pulverized samples were added to methanol for 72 hours, stirred at intervals and filtered with a muslin cloth. The extracts were then concentrated using rotary vacuum evaporator at

37°C and stored in sterilized sample bottles in a refrigerator.

Phytochemical analysis

Phytochemicals were assessed using the methods of Odebeji and Safowara [26] with slight modification.

Radical scavenging activity using the ABTS (2, 2'-azino-bis (3-ethylbenzothiazoline-6-sulfonic acid) Assay

The radical scavenging ability of the plant extract against ABTS radical was assessed following the method described by Re *et al*. [27]. The stock solution for generating ABTS radical was made by adding 7mM ABTS solution and 2.4mM potassium per sulphate (1:1), this was allowed to react in the dark for twelve hours at room temperature. The radical generated was mixed with methanol to obtain an absorbance of 0.702 ± 0.001 unit at 734 nm. 2 ml of the resulting solution was added to the extract or standard (Vitamin C) and absorbance was measured at 734 nm after 7 minutes. The percentage radical scavenging activity was calculated from

$$\text{ABTS radical scavenging activity} = \frac{\text{Abs. of control} - \text{Abs. of test sample}}{\text{Abs. of control}} \times 100$$

Where:

Absorbance of control = Total radical activity without inhibitor.

Absorbance of Test = Activity in the presence of test compound.

Radical scavenging activity using the 2,2-diphenyl-1-picrylhydrazyl (DPPH) Assay

In the analysis of 2,2-diphenyl-1-picrylhydrazyl (DPPH), the stable (DPPH) was used in determining the free radical scavenging activity of the extract according to the method of Makkaret *al*. [28]. Different concentration of the test samples (40-200 μg/ml) and standard were added to the equal volumes of methanol solution of DPPH respectively in the dark for 30 minutes till there was a color change from purple to yellow. Absorbance was measured at 517nm using a UV-VIS spectrophotometer. A lower absorbance value indicated higher radical scavenging activity. The percentage inhibition of DPPH radical of each extract was calculated from the equation

$$\% \text{ DPPH inhibition} = \frac{A_0 - A1}{A_0} \times 100$$

Determination of reducing power: the reducing power of the plant samples was determined according to Hinneburg *et al*. [29], 1ml of different concentrations of the extracts was mixed with 2.5 ml phosphate buffer (200mM and pH 6.6) and 2.5ml potassium ferric cyanide. The resulting mixture was incubated at 50°C for 10mins; 2.5 ml of trichloroacetic acid and centrifuged for 10mins at 3000rpm. The supernatant was mixed with 2.5ml distilled water alongside 0.5ml of 0.1% $FeCl_3$. Absorbance was read at 700nm. Increase of the absorbance of the mixture connoted increase in reducing activity of the extracts assessed.

Statistical Analysis

All data were presented as Mean ± Standard Error of Mean (SEM). Data were subjected to analysis of variance (ANOVA) and Tukey-Kramer multiple comparison test which was performed using an Instat statistical package. The difference was considered significant at $P < 0.05$.

RESULTS

Table 1, shows how much phytochemicals are present in the leaves, stems, roots and seed of *Picrilima nitida*, *Persea Americana* and *Synclisia scabrida* plants. The three plants shows varying amount of phenols, flavonoids, alkaloid and saponins in the leaves, stems, roots and seed.

Table 1: Phytochemical analysis of *Picrilima nitida* (PN); *Persea americana* (PA) and *Synclisia scabrida* (SS) leaves, stems, roots and seeds.

PHYTOCHEMICALS	PA leaves	PN leaves	SS leaves	PA root	PN root	SS root	PN seed	PA stem bark
Phenols	+++	+++	+++	+	+++	++	+++	+ +
Flavonoids	+++	++	+++	+	++	+++	+ +	ND
Alkaloid	ND	+++	+++	+++	+ +	+++	+++	ND
Saponins	+	+	+	ND	ND	+	+	+

- Absent +Present ++Moderately present +++Abundantly present NDNot determined

Table 2, shows that all leave extracts analyzed recorded an inhibitory activity with increase in concentration as can be seen with *Synclisia scabrida* (SS) leaves extract and *Picrilima nitida* (PN) while *Persea Americana* (PA) possessed a significantly lower inhibitory ability compared to the other plant leaves assessed, however, the standard recorded a significantly ($p < 0.05$) higher inhibitory activity at all concentrations.

Table 2: Percentage inhibition of ABTS radical by different concentrations of *Picrilima nitida* (PN), *Persea Americana* (PA), *Synclisia scabrida* (SS) leaves and Ascorbic Acid (Standard)

Concentrations	inhibitory Activity of Extracts (%)			
(µg/ml)	Standard	PN leaves	PA leaves	SS leaves
40	41.01 ± 0.10^{a}	7.29 ± 0.32^{c}	10.51± 2.62^{bc}	13.80 ± 0.28^{b}
80	80.25 ± 1.14^{a}	13.59 ± 0.45^{c}	12.34 ± 0.45^{c}	28.07 ± 0.25^{b}
120	90.53 ± 0.45^{a}	22.98 ± 0.18^{c}	19.67 ± 0.50^{d}	38.05 ± 0.33^{b}
160	93.42 ± 0.16^{a}	29.61 ± 0.34^{c}	24.05 ± 0.44^{d}	58.99 ± 0.33^{b}
200	99.03 ± 0.11^{a}	34.48 ± 0.16^{c}	28.16 ± 0.49^{d}	67.80 ± 0.38^{b}

Data are presented as mean± standard error of mean of triplicate determinations. Values with different alphabetic superscripts within same row are considered to be significantly different ($p<0.05$).

Table 3, show that amongst the leave extracts, *Synclisia scabrida* (SS) leave extract exhibited inhibition of DPPH activity significantly higher at 80µg/ml, 120µg/ml, 160µg/ml and 200µg/ml when compared to the other extract. At all concentration, the standard exhibited a higher inhibitory DPPH radical scavenging activity compared with the extracts.

Table 4, shows that the *Synclisia scabrida* (SS) leaves extract had higher activity compared to the other leaves; it also recorded same effect for DPPH radicals when compared with *Persea Americana* (PA) and *Picrilima nitida* (PN) leaves, however, the standard showed higher inhibitory effects on ABTS and DPPH than the leaves extract analyzed.

Table 3: Percentage inhibition of DPPH radical by different concentrations of *Picrilima nitida* (PN), *Persea Americana* (PA), *Synclisia scabrida*(SS) leaves and Ascorbic Acid (Standard)

Concentrations	inhibitory Activity of Extracts (%)			
(µg/ml)	Standard	PN leaves	PA leaves	SS leaves
40	32.78± 0.35 ^{a}	1.93 ± 0.11 ^{c}	8.82± 1.99 ^{b}	5.46 ± 0.87 ^{bc}
80	48.16 ± 0.24 ^{a}	5.91 ± 0.24 ^{c}	3.56 ± 1.33 ^{c}	17.89 ± 1.50 ^{b}
120	60.46 ± 0.01 ^{a}	11.42 ± 0.45 ^{c}	5.28 ± 1.10 ^{d}	30.36 ± 0.70 ^{b}
160	78.05 ± 0.06 ^{a}	14.72 ± 0.17 ^{c}	8.90 ± 0.82 ^{d}	44.99 ± 0.51 ^{b}
200	90.42 ± 0.13 ^{a}	18.01 ± 0.70 ^{c}	10.25 ± 4.12 ^{d}	61.52 ± 1.23 ^{b}

Values with different alphabetic superscripts within same row are considered to be significantly different ($p<0.05$).

Table 4: IC_{50} value of ABTS and DPPH Radical Inhibitory Activities of *Picrilima nitida* (PN), *Persea Americana* (PA), *Synclisia scabrida* (SS) leaves and Ascorbic Acid (Standard).

Parameters	IC_{50} Value ((µg/ml)			
	Standard	PN leaves	PA leaves	SS leaves
ABTS	24.52	281.40	385.98	145.05
DPPH	87.24	508.74	212.72	171.63

Ic_{50} = Concentration of extract causing 50% inhibition.

Table 5, shows that the percentage inhibition of ABTS radical for *Synclisia scabrida* (SS) root extract was higher than that of *Picrilima nitida* (PN) and *Persea Americana* (PA) root extracts; there was no significant difference between *Picrilima nitida* (PN) and *Persea Americana* (PA) root extracts at 40 and 200 μg/ml. At all concentration, the percentage inhibition of ABTS radical for the standard was the highest.

Table 6, shows that the percentage inhibition of DPPH radical for *Synclisia scabrida* (SS) root extract was higher than that of *Picrilima nitida* (PN) and *Persea Americana* (PA) root extracts; there was no significant difference between *Picrilima nitida* (PN) and *Persea Americana* (PA) root extracts at 40 and 80 μg/ml.

Table 5: Percentage inhibition of ABTS radical by different concentrations of *Picrilima nitida* (PN), *Persea Americana* (PA), *Synclisia scabrida* (SS) root and Ascorbic Acid (Standard).

Concentrations	inhibitory Activity of Extra cts (%)			
(μg/ml)	Standard	PN root	PA root	SS root
40	41.01 ± 0.10 ^{a}	6.57 ± 0.50 ^{c}	5.58 ± 2.80 ^{c}	21.56 ± 0.04 ^{b}
80	80.25 ± 1.13 ^{a}	18.57 ± 0.25 ^{c}	12.27 ± 1.62 ^{d}	44.19 ± 0.02 ^{b}
120	90.53 ± 0.45 ^{a}	27.52 ± 0.42 ^{c}	36.03 ± 0.83 ^{d}	58.35 ± 0.17 ^{b}
160	93.61 ± 0.33 ^{a}	36.59 ± 0.37 ^{d}	42.80 ± 1.39 ^{c}	68.91± 0.32 ^{b}
200	99.01 ± 0.11 ^{a}	66.72 ± 0.33 ^{c}	65.02 ± 0.43 ^{c}	82.17 ± 0.17 ^{b}

Data are presented as mean± standard error of mean of triplicate determinations. Values with different alphabetic superscripts within same row are considered to be significantly different ($p<0.05$).

Table 6: Percentage inhibition of DPPH radical by different concentrations of *Picrilima nitida* (PN), *Persea americana*(PA), *Synclisia scabrida* (SS) root extracts and Ascorbic Acid (Standard).

Concentrations	inhibitory Activity of Extract s (%)			
(μg/ml)	Standard	PN root	PA root	SS root
40	32.78 ± 0.35 ^{a}	1.27 ± 0.32 ^{c}	1.34 ± 0.59 ^{c}	22.42 ± 0.76 ^{b}
80	48.17 ± 0.24 ^{a}	5.72 ± 0.87 ^{c}	2.63 ± 0.83 ^{c}	61.70 ± 5.01 ^{b}
120	60.46 ± 0.01 ^{a}	9.27± 0.74 ^{c}	2.90 ± 0.63 ^{d}	68.97 ± 1.75 ^{b}
160	78.04 ± 0.05 ^{a}	14.05 ± 0.73 ^{c}	7.78 ± 0.65 ^{d}	74.09± 0.57 ^{b}
200	90.42 ± 0.12 ^{a}	26.18 ± 0.69 ^{c}	19.34 ± 4.41 ^{d}	78.53 ± 0.62 ^{b}

Data are presented as mean± standard error of mean of triplicate determinations. Values with different alphabetic superscripts within same row are considered to be significantly different ($p<0.05$).

Table 7, shows that *Synclisia scabrida* (SS) root extract exhibited a higher ABTS radical inhibitory activity at the IC_{50} value than *Picrilima nitida* (PN) and *Persea Americana* (PA) root extracts. The IC_{50} value for *Synclisia scabrida* (SS) root extract (84.24 μg/ml) for the DPPH activity was lower than both the *Picrilima nitida* (PN) and *Persea Americana* (PA) root extracts and the standard (87.00 μg/ml).

Table 8, shows that *Picrilima nitida* (PN) seeds and *Persea Americana* (PA) stem bark had comparable effect at a concentration of 40 μg/ml with the standard exhibiting a higher ABTS activity compared to the extract at all concentrations.

Table 7: IC_{50} value of ABTS and DPPH Radical Inhibitory Activities of *Picrilima nitida* (PN), *Persea americana* (PA), *Synclisia scabrida* (SS) root extracts and Ascorbic Acid (Standard).

Parameters	IC_{50} Value (μg/ml)			
	Standard	PN root	PA root	SS root
ABTS	24.51	174.38	167.29	106.18
DPPH	87.00	386.15	539.82	84.24

Table 8: Percentage inhibition of ABTS radical by different concentrations of *Picrilima nitida* (PN) seeds, *Persea Americana* (PA) stem bark extracts and Ascorbic Acid (Standard).

Concentrations	inhibitory Activity of Extracts (%)		
(μg/ml)	Standard	PN seeds	PA stem bark
40	41.01 ± 0.10^{a}	6.74 ± 0.31^{b}	6.62 ± 0.65^{b}
80	80.25 ± 1.14^{a}	17.54 ± 0.37^{b}	10.12 ± 0.45^{c}
120	90.53 ± 0.45^{a}	25.61 ± 0.43^{b}	13.30 ± 0.14^{c}
160	93.42 ± 0.16^{a}	40.54 ± 0.12^{b}	22.26 ± 0.42^{c}
200	99.03 ± 0.11^{a}	70.53 ± 0.25^{b}	30.58 ± 0.47^{c}

Values with different alphabetic superscripts within same row are considered to be significantly different ($p<0.05$).

Table 9, shows that *Picrilima nitida* (PN) seeds had potent DPPH radical inhibitory effect than *Persea Americana* (PA) stem bark at all concentrations. Compared to the standard *Picrilima nitida* (PN) seeds had a lower DPPH activity.

americana (PA) roots extracts. The reducing potential for the standard was the highest at all concentration except at the 0.2 µg/ml.

Discussion

Phytochemical rich plants have been explored for

Table 9: Percentage inhibition of DPPH radical by different concentrations of *Picrilima nitida* (PN) seeds and *Persea Americana* stem bark extracts and Ascorbic Acid (Standard).

Concentrations	inhibitory Activity of Extracts (%)		
(µg/ml)	Standard	PN seeds	PA stem bark
40	32.78 ± 0.35[a]	9.22 ± 1.29 [b]	1.95 ± 1.43 [c]
80	48.16 ± 0.24 [a]	17.07 ± 0.27 [b]	2.39 ± 0.73 [c]
120	60.46 ± 0.01[a]	22.91 ± 0.24 [b]	2.65 ± 0.68 [c]
160	78.05 ± 0.06	46.09 ± 0.98 [b]	4.94 ± 1.32 [c]
200	90.42 ± 0.13 [a]	56.38 ± 0.97 [b]	11.29 ± 2.19 [c]

Data are presented as mean± standard error of mean of triplicate determinations; Values with different alphabetic superscripts within same row are considered to be significantly different ($p<0.05$).

Table 10: IC_{50} value of ABTS and DPPH Radical Inhibitory Activities of *Picrilima nitida* (PN) seeds and *Persea Americana* stem bark and Ascorbic Acid (Standard)

Parameters	IC_{50} Value ((µg/ml)		
	Standard	PN seeds	PA stem bark
ABTS	24.51	167.50	342.91
DPPH	87.24	183.98	975.94

Ic_{50} concentration of extract coursing 50% inhibition of Ascorbic Acid, *Picrilimanitida*seeds and *Persia americana*stem bark. The higher the IC_{50} value, the lower the inhibitory ability of the extract.

Table 10, shows that *Picrilima nitida* (PN) seeds had a lower IC_{50} value compared to *Persea Americana* (PA) stem bark while that of the standard for ABTS and DPPH was lower than both plant extract.

Table 11, shows that amongst the extracts, *Synclisia scabrida* (SS) root extract displayed the highest reducing potential at all concentration compared to *Picrilima nitida* (PN) and *Persea*

use in pharmacy and medicine for treating varying health issues stemming from free radicals traceable to unpaired electrons in reactive oxygen species (ROS). ROS are products of normal human metabolism and must be continually detoxed from the human body; a shortfall in the detox process of the body leads to oxidative stress and concomitantly this has been traced to be the root cause of some debilitating diseases [4,5]. Folklore holds in its archives lots of

Table 11: Reducing potential of different concentrations of *Picrilima nitida* (PN), *Persea americana* and *Synclisia scabrida* (SS) roots extract and Ascorbic Acid (Standard).

CONCENTRATIONS (µg/ml)	STANDARD	SS ROOT	PN ROOT	PA ROOT
0.2	0.068± 0.008[b]	0.075± 0.002[a]	0.031± 0.001[c]	0.017± 0.003[d]
0.4	0.107 ± 0.007[a]	0.127 ± 0.007[b]	0.046 ± 0.002[c]	0.025 ± 0.001[d]
0.6	0.183 ± 0.001[a]	0.152 ± 0.002[b]	0.68 ± 0.000[c]	0.076 ± 0.006[d]
0.8	0.245 ± 0.002[a]	0.186 ± 0.001[b]	0.089 ± 0.001[c]	0.105 ± 0.005[d]
1.0	0.321 ± 0.005[a]	0.213 ± 0.001[b]	0.119 ± 0.002[c]	0.129 ± 0.002[d]

Data are presented as mean± standard error of mean of triplicate determinations. Values with different alphabetic superscripts within same row are considered to be significantly different ($p<0.05$).

recipes for attenuating these diseases, one of such is the use of plants and plant based product in ravaging free radicals. This prowess is possibly due to their high flavonoid and phenolic content which are responsible for shielding plants from biotic and abiotic stress [30]. It is important to note that the phytochemical analysis of *Picrilima nitida*, *Persea americana* and *Synclisia scabrida* also revealed high content of phenols, flavonoids and alkaloids. These bioactive constituents are renowned for their anti-inflammatory, antimicrobial, anti-carniogentic and anti-diabetic potential [30]. In addition, high content of these polyphenolic phytochemicals have been correlated with high antioxidant activity [31] and this correlation have become the basis for the use of some plants in treating diseases in humans stemming from oxidative stresses [20].

In vitro antioxidant activity has been measured by some assays which includes ABTS, DPPH, FRAP, ORAC; with ABTS and DPPH based on electron transfer. It is advised that more than one assay be used in accessing antioxidant activity due to the fact that using one single assay may not reveal accurately the mechanism of action of all radical source or antioxidant in a complex system [32,33], in this current study we measured the antioxidant properties of *Picrilima nitida*, *Persea americana* and *Synclisia scabrida* using *in vitro* ABTS and DPPH methods. DPPH assay is used to assess the free radical scavenging properties of the plants, it measures the change in the spectrophotometric concentration of DPPH resulting from a reaction with an antioxidant; using ascorbic acid as standard. ABTS assay is based on the change in colour by oxidation of the colourless ABTS to a deep greenish colored ABTS ion which can be measured by reduction of the absorption spectrum and colour change of the ABTS radical while the reducing power is based on the colour change of iron III complex to iron II [34, 35]. A number of studies have supported the radical scavenging activity of the different parts of *Picrilima nitida* and *Persea americana;* for *Picrilima nitida*, our study shows a positive antioxidant properties of the leaves, just as also reported in other literatures [9,13,32,36,] and the peel of *Picrilima nitida* also show positive antioxidant properties [35]. Studies have also supported same ability for *Picrilima nitida* root bark extract as seen in our current study [19]; also for its seeds [21] and stem bark and leaves [20]. Data on *in vitro* antioxidant studies for *Synclisia scabrida* were limited but available are phytochemical and antibacterial studies by Sokomba *et al*. [37] and Anowi*et al*. [22] which are in agreement with our findings on its

phytochemical.

ABTS and DPPH assay revealed a comparable result in antioxidant activities of the methanolic extract of leaves and roots of *Picrilima nitida*, *Persea americana* and *Synclisia scabrida* with *Synclisia scabrida* leaves and root being more potent than *Picrilima nitida* and *Persea americana* leaves and root; *Picrilima nitida* seed was also seen to be more potent than *Persea americana* stem bark under same assay. This trend is also seen in their IC_{50} values which showed a lower value for *Synclisia scabrida* when compared to *Picrilima nitida* and *Persea Americana* leaves and roots extract. This indicates that ABTS and DPPH assays have same predictive power; this also corroborates with the total reducing power capacity of root extract of *Picrilima nitida*, *Persea americana* and *Synclisia scabrida* roots. The reducing power of the root extracts also gave credence to the above findings.

The antioxidant activity seen in all plant parts analyzed is not farfetched from the phytochemicals analysed in this present study which revealed the presence of phenols, flavonoids, saponins, and alkaloid from the plant part analyzed. Researchers has reported that the quantity of phenols and flavonoids correlates positively with the antioxidants activity, although not in all cases as seen when extract with low phenolic content has high antioxidant properties: possibly due to non-phenolic content contributes to antioxidant activity; and when extract with high phenolic content has low antioxidant properties [38-40].

From our study, the *Synclisia scabrida* leaves analyzed had better antioxidant prowess compared to *Picrilima nitida* and *Persea americana* plant parts, this plant is thus promising in the area of antioxidant drug discovering. *Synclisia scabrida* plant parts is underutilized when compared to the other two plants in the region where this experiment was conducted, moreover the use of *Synclisia scabrida* plant parts will suffice in instances of seasonality of both *Picrilima nitida* and *Persea americana* plants.

Conclusion

The results of ABTS, DPPH and reducing power has put forward *Synclisia scabrida* leaves and root to have the most active antioxidant ability when compared with leaves and root of *Picralima nitida* and *Persea americana;* and when also compared with *Picralima nitida* seeds and *Persea americana* stem bark thus, *Synclisia scabrida* can be exploited as source of natural plant antioxidants and in treating diseases connected with oxidative stress which would prove useful in drug discovery. As at the time of this study, there were limiting data on both *in vitro* and *in vivo* antioxidant prowess of *Synclisia scabrida*, hence further works which are needed includes the utilization of *Synclisia scabrida* in treating oxidative diseases such as cardiovascular disease, cancer, diabetics, Alzheimer's disease and osteoporosis through animal models.

Conflicts of interest

There are no conflicts of interest.

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