

Nutritional, phytoconstituents, and free radical scavenging potentials of *Cola lepidota* K. Schum. and *Irvingia gabonensis* (Aubry-Lecomte ex O'Rorke) Baill. leaves

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Abstract. This study was carried out to determine the essential oil components, protein qualities, fatty acid composition, and free radical scavenging potentials of leaves of *Cola lepidota* K. Schum. (Malvaceae) and *Irvingia gabonensis* (Aubry-Lecomte ex O'Rorke) Baill. (Irvingiaceae) using chromatographic and spectrophotometric methods. Thirty five bioactive components were isolated from *C. lepidota* leaves with myrcene, phytol, ephedrine, hexadecanoic acid, and 1,14-tetradecanediol as the main compounds while phytol, 2-furancarboxaldehyde, 5-(hydroxymethyl)-, 1-hexadecyne, carotene, and humulene were the predominant components of the *I. gabonensis* leaves. Leucine and arginine were the predominant essential amino acids, whereas glutamic acid and serine were the main non-essential amino acids in both leaves. The total amino acid (TAA) (70.92 g/100g), total non-essential amino acid (TNEAA) (45.87 g/100 g), and total acidic amino acid (TAAA) (23.01 g/100 g) of *C. lepidota* were high whereas *I. gabonensis* recorded higher Total essential amino acid (TEAA) (28.98 g/100 g), total aromatic amino acid (TArAA) (7.21 g/100 g), total branched chain amino acid (TBCAA) (14.28 g/100g), predicted protein efficiency ratios (P-PERs), and essential amino acid index (EAAI). *C. lepidota* contained 55.72% of unsaturated fatty acids, with predominance of linolenic and linoleic acids, while *I. gabonensis* produced 74.46% of saturated fatty acids, having myristic, lauric, and palmitic acid as the main compounds. All the radical scavenging potentials of both leaves were concentration dependent and produced higher DPPH, hydrogen peroxide, and ABTS radical scavenging potentials than the standards. This study has thus provided the scientific backing for the inclusion of both leaves for dietary and therapeutic purposes.

Keywords: *Cola lepidota*; Monkey kola; *Irvingia gabonensis*; Bush mango; Essential oil; Amino acids; Fatty acids; Free radicals.

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Introduction

The paucity of information, and non existence of a database for properties of local foods and fruits, are major contributors to the under-exploitation of some of the available medicinal plants in nature (Grivetti and Ogle, 2000).

Evidently, in Nigeria, many local fruits and leaves are underutilized and could face extinction. Erosion of practices encouraging the utilization of local medicinal plants could be drawn to the behavioural or lifestyle changes, massive migration to urban areas, and overdependence on popularly positioned resources (Joshi and Joshi, 2005), therefore accounting for the high rate of diet related diseases and malnutrition. In other words, proposing a return to the investigation of local plants holds the key to the adequate provision of nutrients, and other bioactive components for the populace.

Of such underexploited plants, are the leaves of *Cola lepidota* K. Schum. (Malvaceae) and *Irvingia gabonensis* (Aubry-Lecomte ex O'Rorke) Baill. (Irvingiaceae). *C. lepidota* also known as the monkey kola, is one of the members of the *Cola* species, and the Family Malvaceae that bear sweet edible fruits. In Nigeria, they are mostly consumed by the southerners and some Eastern part of Nigeria. The fruits of *C. lepidota* have been widely evaluated for its nutritional and biochemical properties (Pamplona-Roger, 2008; Singh et al., 2010). However, the leaves of this plant have been surprisingly overlooked in terms of nutritional and ethnomedicinal applications.

I. gabonensis is known as bush mango by local inhabitants, and belongs to the Family Irvingaceae which are green tall trees with perennial life cycle. The bush mango boasts of rich ethnobotanical profile due to extensive tradomedical applications for several disease conditions (Lowe et al., 2000; Ezeasor et al., 2017). The seeds also called Ogbono or Ugiri seeds in Igbo, is a known soup thickener, and have been shown to possess weight loss and hypoglycaemic effects coupled with other therapeutic potentials (Rosen and Spiegelman, 2000; Ngondi et al., 2009). However, the leaves of this popular culinary plant have seen little utilization regarding its ethnomedicinal potentials.

We understand that the under-exploitation of the leaves of both *C. lepidota* and *I. gabonensis* have occurred as a consequence of paucity of information about their nutrient composition. Hence, this study was carried out to determine the essential oil, fatty acid, protein qualities, and *in vitro* antioxidant potentials of *C. lepidota* and *I. gabonensis* leaves.

Methods

Sample collection, identification and preparation

Freshly harvested leaves of *C. lepidota*, and *I. gabonensis* were obtained from farmlands at Mbaise in Imo State Nigeria. The leaves were identified by the botanist at Department of Plant Science and Biotechnology (DPSB), Imo State University Owerri and the voucher specimen deposited in the DPSB herbarium.

After cleaning the samples of debris using distilled water, the leaves were dried under open air, and ground continuously to powder size.

Extraction and analysis

Using a Clevenger type apparatus, the hydrodistilled extracts of the samples (100 g) were obtained and analyzed in a HP Chem Station Rev. A 09.01 machine, under the following conditions;

Detector; FID, Injection type and ratio; split and 20:1, inlet temp; 150 °C, Column; HP5MS (of dimension 30 m x 0.25 mm x 0.25 µm, carrier gas; hydrogen, flow rate; 1.0 mL/min, carrier gas pressure; 22 psi, compressed air pressure; 28 psi, oven

parameters; initial temp of 40 °C, run rate at for 2 min at 200 °C, ramping (5 °C/min first and 200 °C/min final).

Identification of the components of essential oils

The chromatogram was interpreted using NIST database from the comparison of the spectrum of the unknown components with the spectrum of the known components stored in the NIST library. The name, percentage areas, and percentage concentrations of the components of the test materials were thus ascertained.

Amino acid analysis of the leaves

The method of Benitez, (1989) was applied for the amino acid content determination of the leaves. Briefly, 100g of the samples were immersed in 500 mL of mixture of chloroform and methanol (2:1) and sieved after 48 h. The extracts were concentrated in a rotary evaporator and were transferred the Amino Acid Autoanalyzer (Technicon Sequential Multi-Sample). Tryptophan was measured colorimetrically following the procedure of Rama Rao et al. (1974).

Determination of protein quality parameters

The groups of amino acids were arithmetically determined following the procedure of Amadi et al. (2017). The estimation of the indicators of protein qualities; Predicted protein efficiency ratios (P-PERs I, II, and III) were carried out using standard equations of Chavan et al. (2001) below:

$$\text{I. PER} = -0.684 + 0.456(\text{Leu}) - 0.047(\text{Pro})$$

$$\text{II. PER} = -0.468 + 0.454(\text{Leu}) - 0.105(\text{Tyr})$$

$$\text{III. PER} = -1.816 + 0.435(\text{Met}) + 0.780(\text{Leu}) + 0.211(\text{His}) - 0.944(\text{Tyr}).$$

The method of Steinke et al. (1980) as modified, was adopted for the determination of essential amino acid index (EAAI) shown below;

$$\text{EAAI} = 9 \sqrt{\frac{\text{mg of Lys in 1g of test protein} \times \text{essential amino acids} + \text{His}}{\text{mg of Lys in 1g of Reference protein}}}$$

Determination of fatty acid methyl esters

The procedure of Agomuo et al. (2017) was adopted for the extraction of the oils from the leaves using a mixture of n-hexane and isopropyl alcohol in a ration of 3:2. The Fatty acid methyl esters (FAMES) were generated by saponifying the extracted oils in a mixture of 3 mL 0.5 M KOH and 2 mL methanol and neutralized in 3 mL of 14% BF₃ in 100 mL hydrochloric acid. Methylation was completed after heating at 90 °C for 10 min. Precisely 1 µL of the FAMES was drawn out and transferred to the chromatography machine for analysis. The chromatography conditions were as follows:

GC Type: Agilent 6890N
Detector: Flame Ionization Detector
Detector Temp: 320 °C
Column: HP INNOWax
Dimension: 30 m x 0.25 mm x 0.25 µm
Inlet temp: 250 °C
Injection type: Split (20:1)
Carrier Gas: Nitrogen
Flow rate: 1.5 mL/min

Carrier gas and compressed air pressure: 22psi and 35psi

Oven conditions: Initial temp (60°C), ramping (first, 12°C/min for 20 min and second, 15°C/min for 3min). The identification of components and peak areas and percentages were obtained using standard chemstation system after matching with standard methyl esters.

Determination of *in vitro* antioxidant properties: DPPH radical scavenging potential

The spectrophotometric method of Shimada et al. (1992) was adopted for the determination of DPPH radical scavenging potentials of the leaves.

The hydrogen peroxide radical % inhibition of the leaves was estimated following the procedure of Ruch et al. (1989) by spectrophotometry.

Nitric oxide radical scavenging potentials of the leaves were spectrophotometrically determined by the procedures of Alam et al. (2013).

ABTS radical scavenging potentials of the leaves were determined according to the method of Pellegrini et al. (2003) at absorbance of 734 nm while the method of Sutharsingh et al. (2011) was adopted to determine the ferric reducing antioxidant potentials.

Result and discussion

Table 1 presents the essential oils isolated from leaves of *C. lepidota*. Till date, no study has characterized the essential oil components of this leaf. Thirty five compounds were quantitated, with phytol, myrcene, benzenamine, ephedrine, hexadecanoic acid, and 1,14-Tetradecanediol, occurring as the main compounds.

Table 1. Essential oil contents of *Cola lepidota*.

S/N	Essential oils	Amount (%)
1	Eucalyptol	1.13
2	Benzofuran, 2,3-dihydro-	0.98
3	trans-2-(1-Pentenyl)furan	2.21
4	Camphene	1.35
5	Linalool	0.76
6	Butanal, ethylhydrazone	0.58
7	2-Acetamido-d-mannitol	0.83
8	Hexanethioic acid, S-ethyl ester	3.29
9	Dotriacontane	0.73
10	Hexatriacontane	0.79
11	3,8-Nonadien-2-one, (E)-	0.87
12	Pentalene, octahydro-1-(2-octyldecyl)-	0.94
13	Pentadecanoic acid	0.57
14	1,14-Tetradecanediol	5.12
15	3,7,11,15-Tetramethyl-2-hexadecen-1-ol	1.08
16	Copaene	1.70
18	Hexadecanoic acid	7.61
19	12-Octadecenoic acid	2.63
20	Phytol	10.49
21	Palmitaldehyde, diallyl acetal	0.94
22	Octadecanoic acid, 2-hydroxy-1-(hydroxymethyl)ethyl ester	0.57
23	Myrcene	11.82

Table 1. Continued.

S/N	Essential oils	Amount (%)
24	Germacrene D	0.75
25	Squalene	0.75
26	1-Pentene, 5-bromo-	1.12
27	1,5-Heptadiene, 2,3,6-trimethyl-	3.00
28	Cardanol	1.06
29	2,6,10-Dodecatrien-1-ol, 3,7,11-trimethyl-, acetate, (E,E)-	1.57
30	1,2-Benzisothiazol-3(2H)-one	1.61
31	Chola-5,22-dien-3-ol, (3 β ,22Z)-	1.24
32	Ephedrine	10.87
33	Ethofumesate	0.83
34	Trilostane	2.79
35	Dodecanoic acid	1.00

The first five compounds were eucalyptol benzofuran, 2,3-dihydro-, trans-2-(1-Pentenyl)furan, camphene, and linalool. Eucalyptol, camphene and linalool are all used as flavourings, insect repellants and for fragrances (Harborne and Baxter, 2001; Yang et al., 2004) while benzofuran, 2,3-dihydro-, trans-2-(1-Pentenyl)furan are not yet associated with any biological effects. Similarly, butanal ethylhydrazone, 2-acetamido-d-mannitol hexanethioic acid s-ethyl ester, dotriacontane, hexatriacontane, 3,8-nonadien-2-one, (e)-, and pentalene octahydro-1-(2-octyldecyl)- have no recorded biological effects yet. Pentadecanoic acid, the 13th isolated compound is an odd chain fatty acid whereas 1, 14-Tetradecanediol, and 3,7,11,15-Tetramethyl-2-hexadecen-1-ol the 14th and 15th compounds have no reported biological properties. Copaene and phytol are potent antioxidants (Türkez et al., 2014; Costa et al., 2016) which provides enough scientific evidence for encouraging the application of *C. lepidota* leaves for antioxidant activities. Hexadecanoic acid (palmitic), and octadecanoic acid (stearic) were the 18th and 19th isolated components thus showing the applicability of the oil from this leaf for producing industrial products like soaps.

Palmitaldehyde, diallyl acetal, and octadecanoic acid, 2-hydroxy-1-(hydroxymethyl) ethyl ester occurred in very low amounts, and have no reported biological usefulness. Myrcene (being the most abundant compound found in *C. lepidota* leaves), with germacrene and squalene are terpenes that possess notable immunologic effects (Mesa and Fernández, 2004; Uyeda et al., 2016).

Hence, *C. lepidota* leaves could be effective for immunotherapy. The presence of cardanol and ethofumesate might indicate slight insecticidal properties of *C. lepidota* leaves (Ping et al., 2005; Mukhopadhyaya et al., 2010), while 2,6,10-Dodecatrien-1-ol, 3,7,11-trimethyl-, acetate, (E,E)-, 1,2-Benzisothiazol-3(2H)-one, and Chola-5,22-dien-3-ol, (3 β ,22Z)- being the 29th-32rd isolated components, possesses no biological usefulness.

Ephedrine occurring in appreciable amount in the *C. lepidota* leaves imply the leaves could suffice as potent weight loss and anti-asthmatic regimen (Shekelle et al., 2003; Mei et al., 2014). Trilostane and dodecanoic acids, the 34th and 35th compounds found in *C. lepidota* leaves, have been found in literature to be effective in inhibiting steroidogenesis (Wenger et al., 2004) and treatment of acne (Takatsuji et al., 2009), respectively, thus broadening the pharmacological applications of *C. lepidota* leaves.

Table 2 shows the essential oil composition of *I. gabonensis*. Thirty two compounds were detected and quantitated with phytol, 2-furancarboxaldehyde, 5-(hydroxymethyl)-, 1-hexadecyne, carotene, humulene, benzothiazinone, and farnesol as the main compounds. Of the first five compounds isolated; azulene, 2-furancarboxaldehyde 5-(hydroxymethyl)-, formamide n-(3-methyl-5-isoxazolyl)-, 3-pyrrolidinol, and ethanone 1-(3-

methoxyphenyl)-, only azulene and 2-Furancarboxaldehyde, 5-(hydroxymethyl)- otherwise known as hydroxymethylfurfural have potent biological effects, as anti-inflammatory and antisickling agents respectively (Andersen, 1999; Abdulmalik et al., 2005).

This validates the bioprospecting of *I. gabonensis* leaves for anti-sickling effects. 1,2,3-benzenetriol, hexanoic acid, hydroxy-, methyl ester, decanoic acid, 2(1h)-quinolinone, 3,4-dimethyl-, hexadecanol, and octanoic acid were the 6th – 11th compound isolated respectively. Among these, only decanoic (capric), octanoic (caprylic) acids, which are food additives, and hexadecanol (cetyl alcohol), used in cosmetics, have recognized uses. Dimethyl 2,5-thiophenedicarboxylate, and hydrazinecarboxamide, 2-(2-methylcyclohexylidene)-, 1,1,3-trimethyl-1-silacyclo-3-pentene, 1-hexadecyne, 9-octadecyne, and 6-Octenal, 3,7-dimethyl- have no reported biological applications, while as shown in the results tetradecanoic acid, pentadecanoic, and hexadecanoic acid were found in low amounts. Further, the occurrence of humulene, farnesol, and phytol in the *I. gabonensis* leaves, among other therapeutic benefits, promotes its usage for anti-inflammatory therapy (Fernandes et al., 2007; Silva et al., 2014; Chi-Mei and Jin-Yuarn, 2015). Cis-lanceol, drimenol trichothec-9-en-4-ol, and kauren-18-ol, acetate, (4 β)- have no biological application yet. Carotene and benzothizone, found in moderate quantities in the *I. gabonensis* leaf, indicates that the extracts might be helpful for amelioration of eye problems, while the benzothiazinone content strongly suggest its usage to combat tuberculosis (Lechartier et al., 2012).

Table 2. Essential oil composition of *Irvingia gabonensis* leaves.

S/N	Component	Amount (%)
1.	Azulene	0.75
2.	2-Furancarboxaldehyde, 5-(hydroxymethyl)-	17.3
3.	Formamide, N-(3-methyl-5-isoxazolyl)-	0.81
4.	3-Pyrrolidinol	1.02
5.	Ethanone, 1-(3-methoxyphenyl)-	0.86
6.	1,2,3-Benzenetriol	0.53
7.	Hexanoic acid, hydroxy-, methyl ester	0.67
8.	Decanoic acid	1.15
9.	2(1H)-Quinolinone, 3,4-dimethyl-	0.7
10.	Hexadecanol	0.99
11.	Octanoic Acid	1.36
12.	Dimethyl 2,5-thiophenedicarboxylate	0.77
13.	Hydrazinecarboxamide, 2-(2-methylcyclohexylidene)-	0.83
14.	Tetradecanoic acid	0.50
15.	1,1,3-Trimethyl-1-silacyclo-3-pentene	1.30
16.	1-Hexadecyne	8.76
17.	Pentadecanoic acid	0.64
18.	9-Octadecyne	1.41
19.	Hexadecanoic acid	2.68
20.	Humulene	6.62
21.	6-Octenal, 3,7-dimethyl-	0.7
22.	Farnesol	3.04
23.	Phytol	25.03
24.	Oleic Acid	4.29
25.	cis-Lanceol	2.31
26.	Carotene	7.90
27.	Drimenol	0.79
28.	Squalene	0.70

Table 2. Continued.

S/N	Component	Amount (%)
29.	Trichothec-9-en-4-ol	0.67
30.	Benzothiazinone	4.05
31.	Kauren-18-ol, acetate, (4 β)-	0.82

The amino acids and protein qualities of both leaves were expressed in Table 3. Both leaves recorded predominance of leucine and arginine over other essential amino acids, whereas glutamic acid and serine were the main non-essential amino acids in both leaves. Both leaves contained lower leucine contents to those of *Basella alba* and *V. amygdalina*, but showed comparable lysine values (Omoyeni et al., 2015). The isoleucine and phenylalanine contents of the leaves in this study, compared with those of popularly consumed vegetables like spinach and water leaf (Arorowa et al., 2017) but contained lower levels of tryptophan.

Valine and methionine found in this study for both leaves were high than the medicinal plants; *C. esculenta* and *I. batatas* reported by (Inyang, 2016). Arginine, histidine, of both plants, and threonine levels of *I. gabonensis* surpassed their respective recommended daily allowances (Ijarotimi and Olopade, 2009). Both plants similarly produced appreciable amounts of non-essential amino acids. The total amino acids for both plants were comparable whereas *I. gabonensis* produced slightly greater total non essential amino acids with and without histidine, total aromatic, basic, sulphur, and branched chain amino acids, while the amount of acidic amino acids were greater in *C. lepidota*. Only *I. gabonensis* produced aromatic amino acids equivalent to the recommended levels for infants (Amadi et al., 2017). Further, the protein quality indices showed the range of P-PERs as 1.03-2.02 for *I. gabonensis*, and 0.81-1.66 for *C. lepidota*. Both values were equivalent to those reported for millet and cowpea (Amadi et al., 2017) while the EAAI values of both leaves compared with soy (Nielson, 2002) and peanut (Adeyeye, 2010) seeds, thus implying that both leaves are suitable protein sources for diet formulations.

Table 3. Amino acid contents and protein qualities of *Cola lepidota* and *I. gabonensis* leaves.

Amino acid	<i>C. lepidota</i> (g/100 g)	<i>I. gabonensis</i> (g/100 g)
Essential amino acid		
Leucine	5.59±0.14	6.29±0.14
Lysine	3.46±0.04	4.54±0.06
Isoleucine	3.24±0.07	3.92±0.06
Phenylalanine	3.20±0.02	3.52±0.10
Tryptophan	0.76±0.02	0.64±0.01
Valine	3.40±0.03	4.07±0.07
Methionine	1.36±0.04	1.12±0.06
Arginine	5.76±0.06	6.18±0.11
Histidine	2.61±0.07	1.58±0.09
Threonine	1.43±0.02	3.30±0.09

Table 3. Continued.

Amino acid	<i>C. lepidota</i> (g/100 g)	<i>I. gabonensis</i> (g/100 g)
Non-essential amino acids		
Proline	2.88±0.09	3.41±0.05
Tyrosine	2.78±0.07	3.05±0.05
Cystine	0.85±0.07	1.24±0.04
Alanine	4.11±0.02	3.71±0.11
Glutamic acid	12.83±0.03	9.71±0.14
Glycine	3.36±0.05	2.90±0.08
Serine	3.12±0.05	3.18±0.16
Aspartic acid	10.18±0.20	7.17±0.15
Amino acid groups		
Total amino acid (TAA)	70.92	69.53
Total non-essential amino acid (TNEAA)	45.87	40.55
Total essential amino acid (TEAA) with His	25.05	28.98
Total essential amino acid (TEAA) without His	23.62	27.40
Total aromatic amino acid (TArAA)	6.74	7.21
Total basic amino acid (TBAA)	10.65	12.30
Total acidic amino acid (TAAA)	23.01	16.88
Total sulphur amino acid (TSAA)	2.21	2.36
Total branched chain amino acid (TBCAA)	12.28	14.28
Protein quality indices		
Predicted protein efficiency ratios (P-PERs) I	1.66	2.02
Predicted protein efficiency ratios (P-PERs) II	1.78	2.06
Predicted protein efficiency ratios (P-PERs) III	0.81	1.03
Essential amino acid index (EAAI)	1.33	1.40

The fatty acid compositions of leaves of *C. lepidota* and *I. gabonensis* were presented in Table 4. *C. lepidota* contained a greater proportion of unsaturated fatty acids, with predominance of linolenic and linoleic acids, while *I. gabonensis* produced 74.46% of saturated fatty acids, having myristic, lauric, and palmitic acid as the main compounds. The result further indicated that both leaves are not richly supplied with short and very long chain fatty acids. For the unsaturated fatty acids, the linoleic acid contents of both plants were similar to those of broccoli, red cabbage and radish, whereas the linolenic acid contents of *C. lepidota* leaves in this study were higher than those reported for artichoke, asparagus, green pepper and egg plant and that of *I. gabonensis* compared with those for chicken pea and carrots (Virdih et al., 2009). Both leaves in this study were similar to wheat germ and olive oil, in terms of their palmitic acid contents, while out of the edible oils (Orsavova et al., 2015) like groundnut oil, sesame oil, rapeseed oil and almond oils, only coconut oil contained higher lauric acids than *I. gabonensis* leaves, but had lower myristic acid level. With higher unsaturated fatty acids, the consumption of *C. lepidota* leaves could improve heart health whereas the higher percentage of unsaturated fatty acids in *I. gabonensis* would require supplementation with richer sources of unsaturated fatty acids.

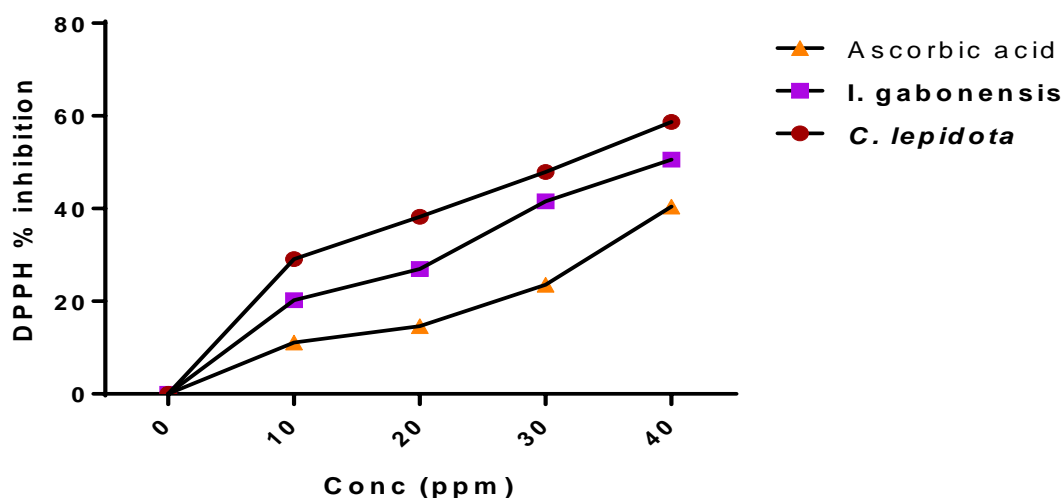
Table 4. Fatty acid composition (%) of *C. lepidota* and *I. gabonensis* leaves.

Fatty acids	Formula	<i>C. lepidota</i>	<i>I. gabonensis</i>
Caprylic acid	C _{8:0}	0.11	1.82
Capric acid	C _{10:0}	0.53	2.00
Lauric acid	C _{12:0}	1.07	21.62
Myristic acid	C _{14:0}	5.63	25.11
Myristoleic acid	C _{14:1}	0.15	ND
Palmitic	C _{16:0}	28.01	16.07
Palmitoleic	C _{16:1}	1.60	2.11
Stearic acid	C _{18:0}	6.44	5.41
Oleic	C _{18:1}	4.21	2.95
Linoleic	C _{18:2}	14.96	16.77
Linolenic	C _{18:3}	33.94	3.50
Arachidic	C _{20:0}	1.85	1.61
Eicosenoic	C _{20:1}	0.41	ND
Eicosadienoic	C _{20:2}	0.14	ND
Dihomo-gamma-linolenic	C _{20:3}	0.05	ND
Behenic	C _{22:0}	ND	0.72
Erucic	C _{22:1}	ND	0.13
Docosadienoic acid	C _{22:2}	0.26	ND
Lignoceric acid	C _{24:0}	0.24	0.08
∑SFA		43.88	74.46
∑UFA		55.72	25.46

Results were mean ± S.D of duplicate determination.

Figure 1 to 5 contains the free radical scavenging properties of *C. lepidota* and *I. gabonensis* leaves. All the radical scavenging potentials of both leaves illustrated in this study were concentration dependent.

The DPPH and hydrogen peroxide radical scavenging potentials of both leaves, presented in Figure 1 and 2, respectively, showed that both leaves produced higher antioxidant effects than those for standard ascorbic acid.

**Figure 1.** DPPH radical scavenging potentials of *C. lepidota* and *I. gabonensis* leaves.

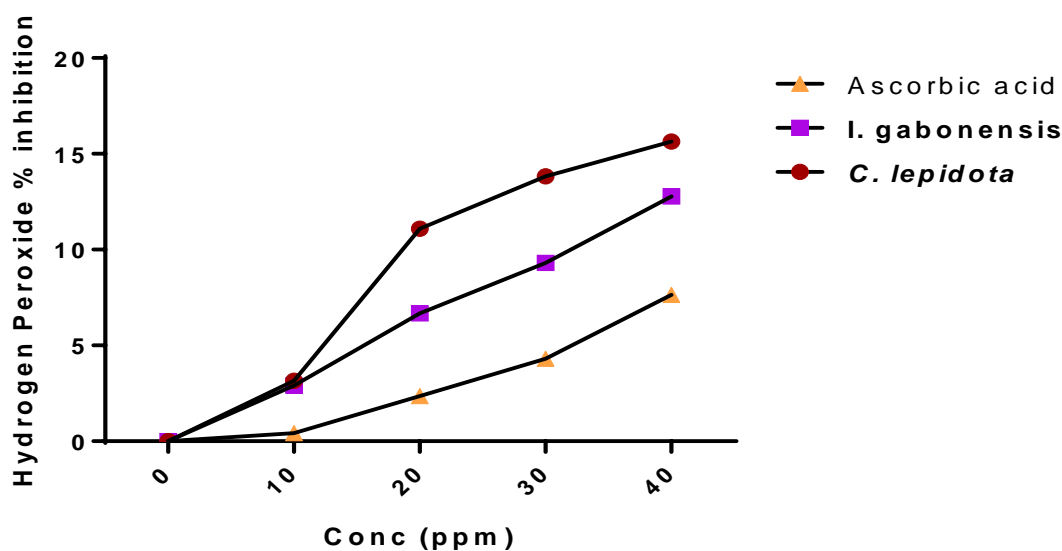


Figure 2. Hydrogen peroxide radical scavenging potentials of *C. lepidota* and *I. gabonensis* leaves.

Both leaves produced similar potentials to scavenge nitric oxide and ABTS radical scavenging potentials (Figure 3). The nitric oxide radical scavenging potentials of both leaves were similar to the standard at 30 and 40 ppm and at 10 ppm for ABTS. At 10 ppm, *I. gabonensis* produced lower FRAP than the standard trolox, but produced comparable effects with *C. lepidota* and trolox at 20 ppm, and higher effects than the trolox at 30 and 40 ppm. The high DPPH and ABTS radical scavenging effects of both leaves imply both leaves are richly supplied with phytoconstituents with hydrogen donating capacities, whereas their rich phenolic acids compositions were implicated by their potent nitric oxide scavenging (Kedare and Singh, 2011; Aluko et al., 2013). Hence, both leaves are dependable sources for the relief of oxidative stress in the system.

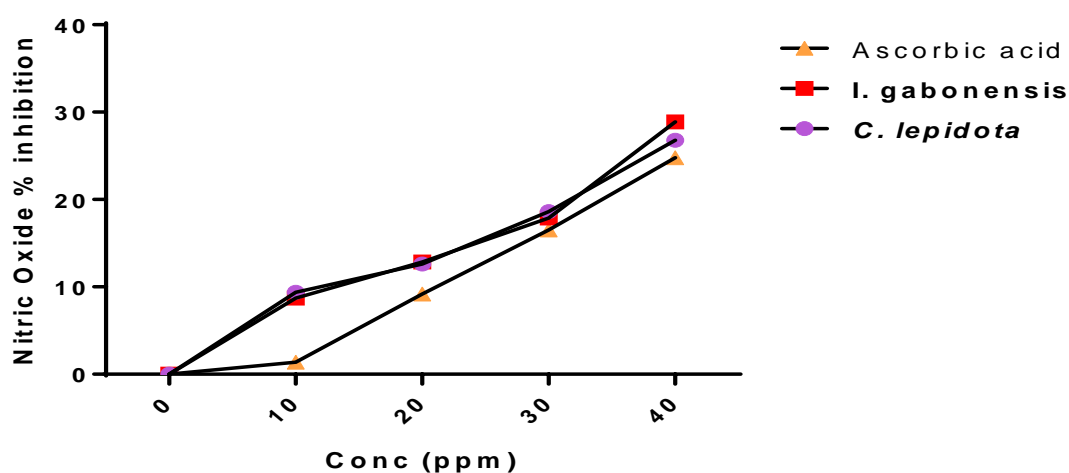


Figure 3. Nitric oxide radical scavenging potentials of *C. lepidota* and *I. gabonensis* leaves.

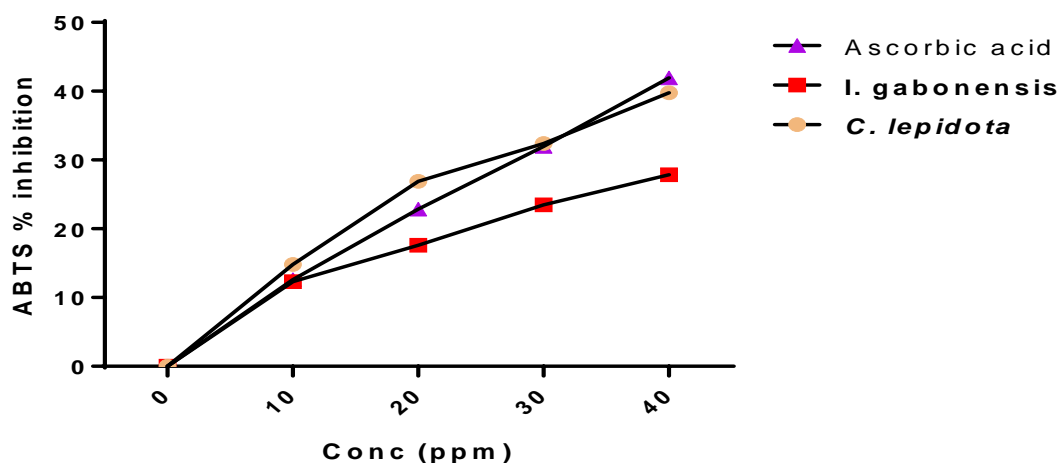


Figure 4. ABTS radical scavenging potentials of *C. lepidota* and *I. gabonensis* leaves.

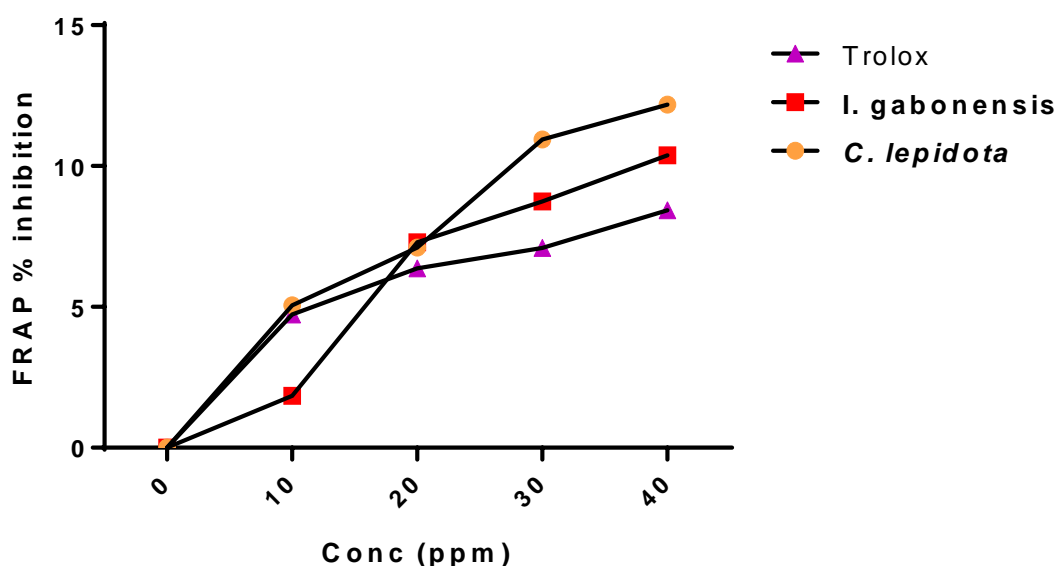


Figure 5. Ferric reducing antioxidant potentials of *C. lepidota* and *I. gabonensis* leaves.

Conclusion

This study has shown that the leaf of *C. lepidota* is richly supplied with components with potent antioxidant and immune boosting potentials whereas *I. gabonensis* leaves were found to contain high quantities of anti-inflammatory and anti-sickling agents. Also both leaves produced high amounts of essential amino acids, and unsaturated fatty acids on par with popularly consumed vegetables as well as demonstrated strong free radical scavenging potentials which in most of the assays were greater than standard antioxidants.

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Conflicts of interest

Authors declare that they have no conflict of interests.

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