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Evaluation Of *In Vitro* Antioxidant, Phytochemical and Gc-Ms Analysis of Aqueous Extract of *Solanum Dasyphyllum* Fruits

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ABSTRACT

Phytochemicals, antioxidant and the bioactive compounds present in the fruits of *Solanum dasyphullum* was investigated. Several phytochemicals such as saponins, tannins, alkaloids, flavonoids, steroids and cardiac glycosides were detected. A total of 172 compounds were identified by GC-MS. Phenols, spermine, 2, 5-dimethylfuran and 2-methyl-1-hexadecanol were all identified. These compounds are known to have antioxidant property which may be responsible for the antioxidant property of the fruit extract. It was observed that the fruits extract exhibit antioxidant properties. The scavenging activity increases with the concentration of the extract with the following percentage scavenging activity; 200µg(90%),133µg (78%), 100 µg(69%), 67 µg(48), 33 µg(26.7%), 20 µg(18), 7 µg(7%). Compounds identified in the fruits of *Solanum dasyphylum* can be isolated and used as an antioxidant.

Keywords: *Solanum dasyphylum*, oxidation, antioxidant and extracts.
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INTRODUCTION

Solanum dasyphyllum belongs to the family of *Solanaceae*. It is the wild progenitor of the cultivated species *Solanum macrocarpon* (https://tropical.theferns.info/viewtropica). Grubben and Denton (2004) and ANON (2007) reported that it has several ethnomedicinal uses as food and medicine in the treatment of fever, skin diseases, inflammation, stomach ache and some systematic infection.
The genus *Solanum* is well known in traditional medicine. *Solanum* species are about 1,500 in the world. In Africa and adjacent islands, it is represented by at least 1500 indigenous species; about 20 of these are a recent introduction. *Solanum macrocarpum* L. "Gorongo" in Kanuri has been used extensively for its fruits, leaves and vegetables (food) and also for medicinal purposes in the North East Arid Zone of Nigeria by the natives (Sodipo et al., 2012). Sodipo et al. (2012) reported that in Nigeria, the fruits are taken as laxatives and to treat cardiac diseases, while flowers and fruits are chewed to clean the teeth; in Kenya, the juice of boiled roots is drunk to get rid of hookworms, while crushed leaves are taken to treat stomach troubles and is occasionally grown as ornamental.
Oxidation is essential to many living organisms for the production of energy to fuel biological processes. Oxidative stress is defined as ‘‘the imbalance between oxidants and antioxidant. Almost all organisms are well protected against free radical damage by enzymes such as superoxide dismutase and catalase, or compounds such as ascorbic acid, tocopherols and glutathione (Niki et al., 1994). Many diseases such as cancer, rheumatoid arthritis, and atherosclerosis have been associated with uncontrollable production of oxygen-derived radicals. Reactive oxygen species (ROS) and nitrogen (RNS) species are products of normal cellular metabolism but when the concentration of these species is high it may

lead to cellular structures damage, such as nucleic acids, lipids and proteins (Halliwell and Gutteridge, 1984).

Antioxidants derived from plants can function as reducing agents by donating electrons to these species preventing them from reacting, free radical scavengers, as complexers of prooxidant metals, as quenchers of the formation of singlet oxygen. Bioactive phenols, especially bioflavonoids, are very interesting antioxidants because of their natural origin and the ability to act as efficient free radical scavengers (Lie and Xie, 2000).

Several chemical and biochemical protocols have been used in the evaluation of antioxidant activity including the oxygen radical absorbance capacity (ORAC), total radical-trapping antioxidant potential (TRAP), total oxidant scavenging capacity (TOSC), chemiluminescence (CL), croton bleaching, low density lipoprotein (LDL) oxidation, ferric reducing antioxidant power (FRAP), copper reduction assay (CUPRAC), 2,2′ azinobis(3-ethylbenzothiazoline-6-sulfonic acid (ABTS) assay, 2,2-diphenyl-1-picrylhydrazyl (DPPH), nitric oxide (NO), hydroxyl radical (OH) hydrogen peroxide (H_2O_2) and total phenolic assay among others (Prior et al., 2005).

The bombardment of the human body by synthetic drugs for the chemotherapeutic control of diseases coupled with its long-term harmful effects have triggered herbal medicines to gain more ground in developing countries. This study was carried out to evaluate the phytochemical, antioxidant properties and bioactive compounds present in aqueous extract of *solanum dasyphyllum* fruits peradventure it can be used as an antioxidant to prevent oxidative stress which has been reported to be the root cause of many diseases.

MATERIALS AND METHODS

Preparation of extracts for phytochemicals screening

Extracts for phytochemicals screening were done using the method reported by Otor et al. (2021).

Acidic extract preparation

10 ml of 2 M HCl was added to 10 g of the aqueous extract of the fruits of *solanum dasyphylum* in a beaker, covered and allowed to stand for 20 minutes. Filtration was done and the filtrate was set aside for analysis.

Alcohol extract preparation

10 g of the aqueous extract of the fruits of *solanum dasyphylum* was weighed into a conical flask containing 10 ml of methanol, covered and left for 30 minutes. It was filtered, poured into a porcelain dish and evaporated on a water bath. It was removed and allowed to cool followed by the addition of 10 ml of chloroform, scratched and stirred to obtain a homogenized mixture.

Phytochemical screening

The phytochemical screening was done according to the method reported by Otor et al. (2021).

Saponins

About 5 ml of water was shaken with 0.1 g of aqueous extract in a test tube. A layer of foam indicated the presence of saponins.

Alkaloid

About 1 ml of acid extract was measured into a test tube followed by the addition of a few drops of picric acid. The appearance of precipitate indicated the presence of alkaloids.

Steroids

About 2 ml of the methanolic extract was measured into a test tube followed by 2 drops of H_2SO_4 on the wall of the test tube (to prevent boiling of the acid). A reddish-brown ring indicated the presence of steroids.

Cardiac glycosides

3 drops of ferric chloride were added to 1 ml of the acid extract in a test tube. The formation of a brown ring indicated the presence of cardiac glycosides.

In vitro DPPH radical scavenging assay

The ability of the fruit extracts of *S. dasyphyllum* to scavenge DPPH free radicals was evaluated using a protocol described by Patel *et al*., (2015).Two milligrams of the extract was dissolved in 2 mL of distilled methanol to obtain a stock concentration of 1000 µg/mL and serial dilutions of 200, 133,100, 67, 33, 20 and 7 µg/mL were prepared in the 96 well- plate by diluting the extracts solutions (100 µL each) with150 µL of DPPH in methanol (0.04 µg/mL). The negative control wells contained only DPPH solution without extract. While varying concentration of ascorbic acid (Sigma-Aldrich, USA) was used as positive control. The micro-plate was incubated in the dark at room temperature (25˚C) for 30 min. Thereafter, the absorbance of the resulting solution was measured at 517 nm using the UV spectrophotometer (JENWAY 310). The experiment was carried out in three replicates. The results were expressed as percentage inhibition and calculated by the formula below (Patel et al., 2015)

$$\% \text{ Absorbance} = \frac{Ac - As}{Ac} \times 100$$

Where Ac is the absorbance of the control (solution

Table 1: Results of phytochemical screening.

Saponins	+
Tannins	+
Flavonoids	+
Alkaloids	+
Steroids	+
Cardiac glycosides	+
Anthraquinones	-

KEY: (+) detected, (-) not detected

containing all the reagents but no extract) while As is the absorbance of the sample.

RESULTS AND DISCUSSION

The result of phytochemicals in Table 1 shows that it contains saponins, Tannins, Cardiac glycosides, Alkaloids, Flavonoids and Steroids which is similar to the work done by Eletta et al. (2017).

Alkaloidal extracts of *Solanum* species have been reported to show analgesic effects and CNS depression (Vohora et al., 2011). The bitterness of eggplants is due to the presence of alkaloids, mainly glycoalkaloids and the degree of bitterness determines to a great extent their edibility. Poisoning by *Solanum* species has been attributed to the presence of toxic glycoalkaloids which cause diarrhea or carcinogenic glycosides causing excessive deposition of calcium in tissues (Eletta et al., 2017). *S. dasyphylum* fruits contain flavonoids which have been reported as an effective antioxidant. Nasunin, an anthocyanin (flavonoid) isolated from egg plant peel, is a potent antioxidant and free radical scavenger and has been shown to protect cell membranes from damage (Noda et al., 2000). Flavonoids also have hypolipidemic effects; flavonoids extracted from the fruits of *S. melongena* showed significant hypolipidemic action in normal and cholesterol-fed rats (Sudheesh et al., 1997)

In-vitro studies have also shown that flavonoids have anti-allergic, anti-inflammatory, anti-microbial and anti-cancer activities (Cushnie and Lamb, 2005). Flavonoids isolated from *S. melongena* showed potent antioxidant activity (Sudheesh et al., 1999). The eggplants, like several *Solanum* species, have antiviral, anticancer, anticonvulsant and anti-infective effects due to the presence of phytochemicals in them. These chemo-preventive agents can enhance host protective systems, such as detoxification enzymes against carcinogens, more effectively by their synergistic actions.

Saponins, which are present in the samples, are important dietary supplements and nutraceuticals. They possess antimicrobial activities and protect plants from microbial pathogens. Researchers have discovered that saponins present in traditional medicine preparations cause hydrolysis of glycosides from terpenoids which avert the toxicity associated with the intact molecule (Xu et al., 1996). The presence of saponins in the eggplants justifies their use in traditional medicine.

Table 2 shows that a total of 172 compounds were identified with an elution time of 47.77 minutes. A total of thirteen peaks within this period. Most important among the compounds identified are phenols and spermine which is known for their anti-oxidant properties (Lovaas, 1995). Spermine is an important epidermal antioxidant. It was reported that the administration of spermine improves the antioxidant status of the liver and spleen, including enzymatic antioxidants and non-enzymatic antioxidants (Xianjian et al., 2017).

2,5- dimethylfuran serves as a scavenger for singlet oxygen, a property that has been exploited for the determination of singlet oxygen in natural water. The mechanism involves a Diels –Alder reaction followed by hydrolysis, leading to diacetylethylene and hydrogen peroxide as a product (Patrick, 1994).

Identification of 2-methoxy furan is also significant. Furan, a five-membered heterocyclic, is a volatile, fairly stable compound which arises from the decomposition of sugars (Olaniyi et al., 1998).

Hexadecane, a derivative of the constituent 2-methyl-1-hexadecanol has been reported to be responsible for the anti-bacterial and antioxidant properties of the essential oil of *cestrum noctrumnum* (Yogeswari et al., 2012).

2-methyl tricosane has been identified from a lot of essential oil of medicinal plant and 3,7-dimethyloctyl acetate a flavoring agent(http://eur-lex.europa.eu/legal-content/EN/TXT).

The results in Table 3 show the scavenging activities of *S. dasyphylum* fruits. It was observed that the highest scavenging activity was 93 % at a concentration of 200 µg of the extract. The scavenging activity of the extract increases with concentration. The result is similar to the work done by Eletta et al. (2017) in which the scavenging activity increases with concentration. The scavenging activity in this study is lower than the standard in which the free radical scavenging is 100% at a concentration of 67 µg. The results obtained are in contrast to the one obtained by Sodeinde et al. (2019) and Anosike et al. (2015) in which the scavenging activity of the fruits extract of *S. dasyphylum* was weak and this may be as a result of the solvent used. Flavonoids and polyphenols

Table 2: Identified compounds by GC-MS.

PK	Compounds	RT	Area %
1	2,5- dimethyl-Furan	6.403	0.550
2	Furfural	6.403	0.550
3	Styrene	7.880	0.340
4	Bicyclo[4,2,0]octa-1,3,5-triene	7.880	0.34
5	Methylene Chloride	8.515	0.08
6	3,4-dihydro-2H-Pyran	8.944	0.53
7	2,3-dihydro-4-methyl Furan	8.944	0.53
8	2-Butenal-2-methyl	8.944	0.53
9	5-methyl-2-Furan Carboxaldehyde	10.603	0.11
10	3-methyl pyridazine	11.164	0.15
11	Phenol	11.164	0.15
12	Spermine	11.393	0.07
13	Benzene-1-4-dichloro	12.143	0.05
14	Benzoic acid methyl ester	14.872	0.38
15	Dichloro acetic acid	14.992	0.19
16	2-Bromo propionic acid,6-ethyl-3-octyl ester	14.992	0.19
17	Azulene	17.556	0.92
18	1-Methylene-1H-Indene	17.556	0.92
19	Naphthalene	17.556	0.92
20	2,3,3-Trimethyl-1-hexene	17.727	0.27
21	Octyl-cyclodecane	17.727	0.27
22	Cyclooctane carboxylic acid	17.727	0.27
23	2,6-dimethyl decane	18.013	0.28
24.	Carbonic Acid,nonyl vinyl ester	18.013	0.28
25	2-methyl Tricosane	18.013	0.28
26	Cis,cis,cis-1-isobutyl-2,5-dimethyl icyclohexane	18.122	0.71
27	1,3-dimethyl-(3,7-dimethyl octyl)cyclohexane	18.122	0.71
28	1,1-Bicyclooctyl	18.122	0.71
29	Hexyl cyclohexane	19.123	0.82
30	Butyl cyclohexane	19.123	0.82
31	Octyl cyclohexane	19.123	0.82
32	1-methyl-1-Naphthalene	20.686	0.29
33	1,4-dihydro-1,4-methanonaphthalene	20.686	0.29
34	3-(2-methylprop-1-enyl thio)-2-methylprop-1-ene	20.686	0.29
35	2-Bromopropionic acid,6-ethyl-3-octyl ester	20.811	0.12
36	1-ethylidiene-1H-Indene	21.160	0.07
37	1,4-dihydro-1,4-methanonaphthalene	21.160	0.07
38	Pentafluoropropionic acid, undecylester	21.750	0.26
39	Cyclotetradecane	21.750	0.26
40	n-pentadecanol	21.750	0.26
41	Trans-2-methyl-4-n-butylthiane,s,s-dioxide	22.196	0.37
42	Oxalic acid-1-methyl pentadecyl ester	22.196	0.37
43	2,6,10,14-tetramethyl pentadecan-3-one	22.499	0.068
44	1,2,4,5-tetraethyl- (1.alpha.,2 alpha.,4.alpha 5.alpha.)-cyclohexane	22.620	0.68
45	2-Butenedioic acid (Z)-monodecylester	22.620	0.68
46	Trichloroacetic acid, decyl ester	22.711	0.26
47	N-isopropoxy-2-carbomenthyloxy aziridine	22.711	0.26
48	Oxalic acid-1-methyl octadecyl ester	22.711	0.26
49	Quinuclidine	22.808	0.08
50	Cis-undec-4-enal	23.060	0.12
51	(E)-4-Decenal	23.060	0.12
52	Trans undec-4-enal	23.060	0.12
53	1-Pentadecene	23.238	2.37
54	(E)-9-Octadecene	23.238	2.37
55	Cetene	23.238	2.37
56	2,2-dimethylpentyl cyclohexane carboxylate	23.346	0.16
57	Bis1,1-(1,2-dimethyl-1,2-ethanediyl) cyclohexane	23.346	0.16
58	5,7-dimethyl Undecane	23.432	0.58
59	2,6,10-trimethyl Tetradecane	23.432	0.58
60	Hexadecane	23.432	0.58
61	2,6,10,14- Tetramethyl-7-(3-methyl-pent-4-enylidene)Pentadecane	23.632	0.40
62	Oleylalcohol trifluoroacetate	23.632	0.40
63	1-cyclopentyl-4-(3-cyclopentyl propyl)-Dodecane	23.632	0.40

Table 2: Contd.

64	Chloromethyl-7-chlorododecanoate	24.428	0.13
65	N-methyl piperidine-3-carboxamide	24.428	0.13
66	Trichloroacetic acid,undec-2-enyl ester		
67	Octyl cyclohexane	24.634	0.89
68	[4-(1,1-dimethylethyl)phenyl]trimethy-silane	26.213	0.41
69	2,4-di-tert-butyl phenol	26.213	0.41
70	Benzeneacetic acid-4-(1,1-dimethyl)methyl ester	26.213	0.41
71	1-Tetracosene	26.327	0.15
72	1,7-dimethyl-1,4-(1-methylethyl) cyclodecane	26.327	0.15
73	Formic acid dodecyl ester	26.327	0.15
74	Cyclohexanecarboxylic acid-4-methyl pentyl ester	27.500	0.11
75	2-Octyldecyl acetate	27.500	0.11
76	(z,z)-5,6-bis(2,2-dimethylpropylidene)-,Decane	27.500	0.11
77	3,7-dimethyloctyl acetate	27.912	0.24
78	Carbonochloridic acid,decyl ester	27.912	0.24
79	Chloroacetic acid, octyl ester	27.912	0.24
80	4-Heptaflourobutyryloxyhexadecane	27.912	0.24
81	(E) -5-octadecene	27.912	0.24
82	Eicosane	28.227	1.40
83	Methoxyacetic acid,2-tetradecyl ester	28.227	1.40
84	1-Hexadecanol	28.599	0.22
85	(1-propenylsulfonyl)-(z)-Benzene	28.777	0.22
86	N-(4-pyridinylmethylene)-benzeamine	28.777	0.22
87	Benzophenone	28.777	0.22
88	1-Cyclohexylnonene	29.326	0.29
89	Undec-10-ynoic acid dodecyl ester	29.326	0.29
90	8-Pentadecanone	29.869	0.76
91	2,3,4,5-Tetrahydropyridazine methylene chloride	29.972	0.08
92	[(2,2-dibromocyclopropyl)methyl]benzene	30.442	0.27
93	5-Phenylisoxazoline	30.442	0.27
94	1,1,3-trimethyl cyclopentane	30.802	0.14
95	3-(Benzylthio)acrylic acid methyl-5-oxazolidinone	30.951	0.61
96	3-Nitroso-2-phenyl-4-(phenylmethyl)5-oxazolidinone	30.951	0.61
97	Benzyl isobutyl carbonate	30.951	0.61
98	Oxalic acid ally octadecyl ester	31.446	0.11
99	Trichloroacetic acid dodecyl ester	31.446	0.11
100	Dichloroacetic acid tridecyl ester	31.446	0.11
101	Bis-trans-1,1-(1,2-cyclobutanediyl) Benzene	31.638	4.36
102	Trans-1,3-diphenyl cyclobutane	31.638	4.36
103	[2,2]paracyclophane	31.638	4.36
104	1-Methoxy-13-methyl Hexadecane	31.798	0.10
105	1-Tetradecene	31.796	0.10
106	Carbamodithioic acid dibutyl methyl ester	31.935	0.21
107	2-methyl-1-hexadecanol	31.935	0.21
108	3,7-dimethyloctyl acetate	32.278	0.14
109	3,21,28-triol-28-acetate,(3.beta.,21.beta.)Lup-20(29)-ene.	32.278	0.14
110	1-Nonadecene	32.399	4.24
111	Tetradecane-1-iodo-methoxyacetic acid-2-tetradecyl ester	32.536	0.63
112	3,4,5,6-tetramethyl octane	32.536	0.63
113	2,6-octadien-1-amine-3,7-dimethyl	33.709	0.29
114	Cyclobutanecarboxylic acid-1-cyclopentylethyl ester	33.709	0.29
115	Cis-cyclohexane-1-(cyclohexylmethyl)-4-methyl	33.707	0.29
116	Heptylcyclohexane	33.846	0.69
117	Octylcyclohexane	33.846	0.69
118	n-Hetadecylcyclohexane	33.846	0.69
119	10-Nonadecanone	34.058	1.17
120	8-Octadecanone	34.058	1.17
121	Hexadecanoic acid,methyl ester	35.071	1.45
122	Pentadecanoic acid-14-methyl-methyl ester	35.071	1.45
123	Benzenepropanoic acid-2,5-bis(1,1-dimethylethyl)-4-hydroxy-methyl ester	35.454	3.12
124	2-Butenoic acid-3-amino ethyl ester	35.677	0.24
125	n-hexadecanoic acid	35.677	0.24
126	Pentadecanoic acid	35.677	0.24
127	3,3-dimethyl-1-butene	35.809	0.30
128	N,N'-bis(3-aminopropyl)-1,3-propanediamine	35.923	0.11

Table 2: Contd.

129	2-ethyl-2-methyl oxirane	35.923	0.11
130	N-methylene-n-hexadecylamine	35.923	0.11
131	2-Octanol,pentafluoropropionate	36.335	0.08
132	Cycloeicosane	36.355	1.80
133	Carbonic acid decyl nonyl ester	36.455	0.28
134	Carbonic acid, eicosyl vinyl ester	36.455	0.28
135	1-octadecanesulphonyl chloride	36.455	0.28
136	2,6-octadien-1-amine-3,7-dimethyl-1- undecanol	36.455	0.28
137	n-pentadecyclohexane	37.806	0.41
138	2-chloroethyl linoleate	38.334	0.73
139	9,12-octadecadienoic acid (z,z)-9 Nonadeyne	38.224	0.73
140	Trans-13-octadecenoic acid methyl ester	38.332	0.76
141	Cis-10-heptadecenoic acid methyl ester	38.332	0.76
142	Methyl Stearate	38.790	0.39
143	Pentafluoropropoinic acid tetradecyl ester	39.952	0.44
144	Nonadecyl trifluoroacetate	39.952	0.44
145	Carbonic acid octadecyl-2,2,2-trichloroethyl ester	39.952	0.44
146	(s)-12-methyl methyl ester Tetradecanoic acid	38.790	0.39
147	2-Bromopropionic acid-6-ethyl-3-octyl ester	40.043	0.11
148	Cyclododecanemethanol	40.043	0.11
149	(z)-14-Tricosenyl formate	40.043	0.11
150	(1S,2R,3E,7E,11E)-2,16,19-Trihydroxycembra-3,7,11,15- Tetraene	41.416	0.21
151	1-Silacyclo-3-pentene methylene chloride	41.416	0.21
152	1,3,5-triphenyl cyvclohexane	44.192	6.80
153	Carbonic acid monoamide,N-benzyl-N-propyl-methyl ester	44.192	6.80
154	1-Benzylindole	44.192	6.80
155	Trans-(2,3-diphenylcyclopropyl)methyl phenyl sulfoxide	45.657	11.98
156	Methadone N-oxide	45.657	11.98
157	Thiocarbomic acid N,N-dimethyl,S-1,3-dipehenyl-2-butenyl ester	45.657	11.98
158	Trans-(2,3-diphenylcyclopropyl)methylphenylsulfoxide	47.448	1.62
159	1-(2-methyl allyl)-1,2,3,3-tetrahydronaphthalen-2-ol	47.448	1.62
160	2-propenentrile-3-phenyl-(E)	47.448	1.62
161	Thiocarbamic acid N,N-dimethyl,S-1,3-diphenyl-2-butenyl ester	47.774	0.33
162	Adamantane-1-(3,3-dichloropropyn-1-yl)	47.774	0.33
163	N-(2,4-diflourophenyl)-2-(4-trifluoromethyl-6-methyl-2-pyrimidylthio-acetamide	47.774	0.33
164	[h]quinolone-2,4-dimethyl-Benzo	46.131	6.17
165	Cyclobutanecarboxylic acid-1-cyclopentyl ethy ester	36.455	0.28
166	(E)-9-octadecenoic acid methyl ester	38.332	0.76
167	2-Methyl-3-phenyl-1H-Indole	45.868	11.98
168	5-Methyl-2-phenylindolizine	45.868	18.80
169	5-methyl-2-phenyl 1H-Indole	45.966	5.47
170	Trans-(2,3-diphenyl cyclopropyl)methylphenyl sulfoxide	45.966	5.47
171	Methadone N-oxide	45.966	5.47
172	1-methyl-1,2-phenyl 1H-Indole	46.131	6.17

Table 3: Scavenging activity.

Amount of extract (µg/ml)	%Scavenging activity of *S .dasyphylum*
267	93
200	90
133	78
100	69
67	48
33	26.7
20	18
7	7
0	0

have been associated with DPPH antioxidant activity and many fruit or plants rich in flavonoids content often display high antioxidant properties (Wojdylo et al., 2007).

The leaf and fruit extracts of *S. dasyphyllum* displayed weak DPPH radical scavenging activity. The poor DPPH radical scavenging activity of the extract may be associated with the poor flavonoids and tannins content of the extracts. Flavonoids and polyphenols have been associated with DPPH antioxidant activity and many fruit or plants rich in flavonoids content often display high antioxidant properties (Wojdylo et al., 2007). Other related species such as *Solanum aethiopicum* (EC50 of 62.73) and *S. nigrum* leaf (EC50 of 25.51) have been evaluated for DPPH radical scavenging activity and they were observed to have mild DPPH radical scavenging activity (Anosike et al., 2015).

Conclusion

The results of the antioxidant have shown that the fruits of *S. dasyphulum* have high antioxidant property. The antioxidant property can be as a result of the combined effect of the identified compounds such as phenols, spermine, flavonoids, 2,5- dimethylfuran and 2-methyl-1-hexadecanol. These compounds can be isolated and used as an antioxidant.

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