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RESEARCH ARTICLE

CHEMICAL COMPOSITION, ANTIOXIDANT AND ANTIMICROBIAL ACTIVITIES OF *ACACIA SEYAL* STEM DRY DISTILLATE

***Ikram Mohamed Eltayeb, Eiman Salah Eldin, Jihad Hasab Elrasoul and Saad Mohamed Hussein Ayoub**

Department of Pharmacognosy, Faculty of Pharmacy, University of Medical Sciences and Technology, P. O. Box 12810, Khartoum, Sudan

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ABSTRACT

In Sudanese traditional medicine *Acacia seyal* is a very important plant, it has valuable uses in cosmetic and for treating of many diseases and infections. The pleasantly fragrant stem fumigate bath, known as *Dokhan,* is used for cosmetic and medicinal purpose, mainly for the treatment of vaginal and urinary tract infections. Searching for new sources of naturally occurring antioxidants and antimicrobial become of interest, due to the carcinogenic effect of synthetic antioxidants, and resistance of antimicrobial agents by microorganisms. The present study represents the first attempt to investigate the content and chemical composition, antioxidant and antimicrobial activities of the dry distillate of *A. seyal* stem. The brown dry distillate (4.0 %v/w) was prepared using dry distillation method. The antioxidant activity assayed by using DPPH radical scavenging was found to be 94±0.01% compared to propylgallate, standard antioxidant agent 90±0.01. The results of antimicrobial using disc diffusion techniques showed remarkable activity with inhibition zone range of 15-25mm. The constituents of the oily dry distillate investigated by GC-MS technique showed detection of one hundred and twenty two compounds. The main constituents identified are Solerone (7.27%), Furfural (7.15%), Catechol (7.11%), Syringol (5.56%), Allo-Inositol (4.86%), Mequinol (4.81%), Furfuralcohol (3.35%), 3-Methyl-1,2-cyclopentanedione (3.24%), Phenol (2.73%), Homovanillyl alcohol (2.56%) and 3-Cresol (2.11%).

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INTRODUCTION

The use of plant extracts as antimicrobial agents are recently of great significance in therapeutic treatment (WHO, 2005). In addition to the plant materials used on the basis of their antioxidant potency seems to be of central importance (Georgetti *et al*., 2003; Chang *et al*., 2009; Tibiri *et al*., 2010; Gallegos-Tintoré *et al*., 2010). Higher plants studies are involved in the identification and isolation of the new therapeutic compounds of medicinal importance (Gadhiv *et al*., 2013). Fabaceae family is a large important family found in tropical forests in Africa and America. *Acacia* is an important genus of the family (White, 2006; https://www.waynesword.palomar.edu/legume1html). In Sudan there are about thirty one species of importance *Acacia* (Orwa *et al*., 2009; Kordofani and Ingrouile, 1992). *Acacia seyal* locally known as *Talih* (Hassan *et al*., 2014) is the most common (Roothaert and Franzel, 2001; http://www.feedipedia.org/node/341). The plant is well known in Sudanese traditional medicine, the stem is widely used to treat fungal infection mainly genital yeast infections. It showed anti diabetic and cholesterol-lowering properties, used as chewing sticks with an antimicrobial activity. The stem, leaves and gum are used in phytotherapy for haemorrhage, colds, diarrhea, gastro-intestinal disorders, jaundice, biliary diseases, syphilis, headaches and as emollient, astringent, for burns and ophtalmia (Hassan *et al*., 2014). A bark decoction is used against leprosy and dysentery, as stimulant and purgative agent, as aphrodisiac with cytotoxic activity, as a pharmaceutical constituent in making emulsions and torches, as masking agent for bitter substances (http://www.worldagroforestry.org/treedb2/speciesprofile). A root decoction mixed with leaves of *Combretum glutinosum* and curdled milk causes strong dieresis (http://www.world agroforestry.org/treedb2/speciesprofile). The family Fabaceae produces more nitrogen containing secondary metabolites than other plant families such as quinolizidine, pyrrolizidine, indolizidine, piperidine, pyridine, pyrrolidine and many other nitrogenous compounds (Van-Wyk, 2013). *Acacia* genus was reported to

****Corresponding author: Ikram Mohamed Eltayeb,***
Department of Pharmacognosy, Faculty of Pharmacy, University of Medical Sciences and Technology, P. O. Box 12810, Khartoum, Sudan.

have many secondary metabolites such as mines, alkaloids, cyanogenic glycosides, cyclitols, fatty acids and seed oils, fluoroacetate, amino acids, terpenes, diterpenes, triterpenes, phytosterol, saponins, polysaccharides, hydrolyzable and condensed (Duke, 1997). *A. seyal* is highly nitrogen-fixing and moderately salt tolerant species it is characterized with high contents of proteins, phenols and flavonoids (Plos one 2015). In Sudan the aromatic oil from the plant traditionally used by Sudanese women posses many preservative and therapeutic values, it posses many beneficial properties (http://www.world agroforestry.org/treedb2/speciesprofile; Shuttleworth, 2011). The pleasantly fragrant fumigate bath of the stem known as *Dokhan*, is widely used by Sudanese women for cosmetic and medical purposes. It use for, cleanness and perfuming, although women insist on the benefits of *Dokhan* for health reasons mainly the treatment of vaginal and urinary tract infections, curing body aches, restoration after child birth and to relieve rheumatic pain. The objectives of this study are to investigate constituents, antioxidant and antimicrobial activates of the dry distillate (*Dokhan*) of *A. seyal* stem.

MATERIALS AND METHODS

Plant Material Collection and Preparation

The sample of *A. seyal* stem was collected from Omdurman local market, Sudan, and identified by taxonomist at the department of Siliviculture, Faculty of Forestry, University of Khartoum. The voucher specimen was deposited at the Department of Pharmacognosy, Faculty of Pharmacy, University of Medical Science and Technology. The plant material was chipped into small sample and used for the study.

Phytochemical and Physiochemical Screening

The phytochemical constituents of the plant material were detected using standard procedure as described by Sofowora (Farhat *et al*., 2011), Prashant *et al*. (2011) and Mosa *et al*. (2014). The physiochemical parameters of the plant material were detected according to the methods described by the WHO (1998).

Preparation of Dry Distillate and Determination of Physiochemical Properties

The dry distillate was prepared from the plant sample using distillation technique described by lewandowki and Milchert (Lewandowki and Milchert, 2011) with a minor modification. The percentage yield was determined in (v/w) and (w/w) with reference to the dried sample weight. Solubility, specific gravity, refractive index, acid value, ester value and saponification value of the prepared dry distillate were determined according to the British Pharmacopoeias (British Pharmacopoei, 2002).

Antioxidant activity test

The antioxidant activity of the distillate was assayed according to the free radical scavenging method described by Mensor *et al*. (2001) and Kexue *et al.* (2006). In the assay, 10 µl from the extracts (5mg/ml) were added to 90µl of 300µM DPPH solution placed in a 96-well microtiter plate. The test samples were dissolved in DMSO while DPPH was prepared in ethanol. The mixture was incubated in the dark at room temperature for 30 min. After incubation, the absorbance of the remaining DPPH was read against a blank at 517 nm using multiplate reader spectrophotometer. Propylgallate was used as the positive control and DMSO as the negative control. All tests and analyses were carried out in triplicate. The inhibition of free-radical DPPH in percent (%) or the capacity to scavenging the DPPH radical (radical scavenging activity) was expressed as EC_{50} value (mg ml-1), and calculated by the following equation:

$$\text{Scavenging activity (\%)} = \frac{(\text{A control} - \text{A sample})}{\text{A control}} \times 100$$

Antimicrobial activity test

The antimicrobial activity of the distillate was carried out using disc diffusion technique as described by the National Committee for Clinical Laboratory Standards Guidelines. The organism suspension was diluted with sterile physiological solution to 10^8 cfµ/ml (turbidity= McFarland standard 0.5). One hundred micro liters of suspension were swabbed uniformly on the surface of Mueller Hinton agar (MHA) and the inoculum was allowed to dry for 5 minutes. Sterilized filter paper discs (whatman No. 1.6 mm in diameter) were placed on the surface of the MHA agar and soaked with 20ul of a solution of each dry distillate (50ml). The inoculated plates were incubated at 37^0c for 24 hours in the inverted position and inhibition zones diameters were measured (Kavanagh, 1972).

Determination of Minimum Inhibitory Concentration (MIC)

The MICs values were determined by agar disc diffusion method. The plates were prepared into series diluted concentrations of the plant extract (Kavanagh, 1972).

GC-MS analysis

The gas chromatography-Mass spectrometry analysis was carried out on gas chromatograph coupled to a mass spectrometer (GC-MS QP). The temperature was programmed at 180^0C for 2 min. at rate of 10c/min, and then increased to 289^0C for 1 min. at rate of 15c/min, the dry distillate was injected with split injection mode. The identification of different components was achieved from their mass spectra and retention time (RT), compared to those in NIST library (http://webbook.nist.gov/chemistry/NIST Standard Reference Database 69: NIST Chemistry WebBook). The fragmentation pattern of major constituents was carried out and their m/z value was compared with those obtained in the Mass spectra.

RESULTS AND DISCUSSION

The results of phytochemical screening and physiochemical parameters of *A. seyal* stem are reported in table 1. The result showed the presence of flavanoids, alkaloids, tannins, terpeniods, cardiac glycosidse and reducing sugars. These findings are reported for the first time about the secondary metabolites of *A. seyal* stem and are compatible with the secondary metabolites found in the Fabaceae family (Shuttleworth, 2011). The physiochemical results showed high percentage of crude fiber content, moderate protein content and total ash content fallowed by alcohol extractable matter, aqueous extractable matte and finally petroleum ether extractable matter. These findings are reported for the first time about the physiochemical parameters of *A. seyal* stem.

Table 1. The results of phytochemical screening and physiochemical properties of *A. seyal* Stem

Phytochemical Screening		Physiochemical Properties (%)	
Secondary Metabolite Test	Result	Test	Result
Flavoniod	+ve	Total ash	6.4475
Alkaloid	+ve	Alcohol extractable matter	3.666
Tannins	+ve	Hot water extractable matter	4.885
Saponin	-ve	Petroleum ether extractable matter	2.748
Steroid	-ve	Crude fiber content	47.34
Terpenoid	+ve	Protein content	6.125
Cardiac glycoside	+ve	_	_
Reducing sugar	+ve	_	_

Table 2. Antimicrobial Activityresult of *A. seyal* Stem Dry Distillate

Tested Organism	Inhibitory Zone Diameter (IZD)	MIC Value
Candida albicans	19 mm	6.25 µl
Aspergillus niger	25 mm	6.25 µl
Staphylococcus aureus	15 mm	12.5 µl
Escherichia coli	20 mm	6.25 µl
Pseudomonas aeruginosa	22 mm	6.25 µl
Bacillus subtilis	18 mm	12.5 µl

6-10 mm= minimum activity; 10-14 mm = intermediate activity; 14 mm > high sensitive

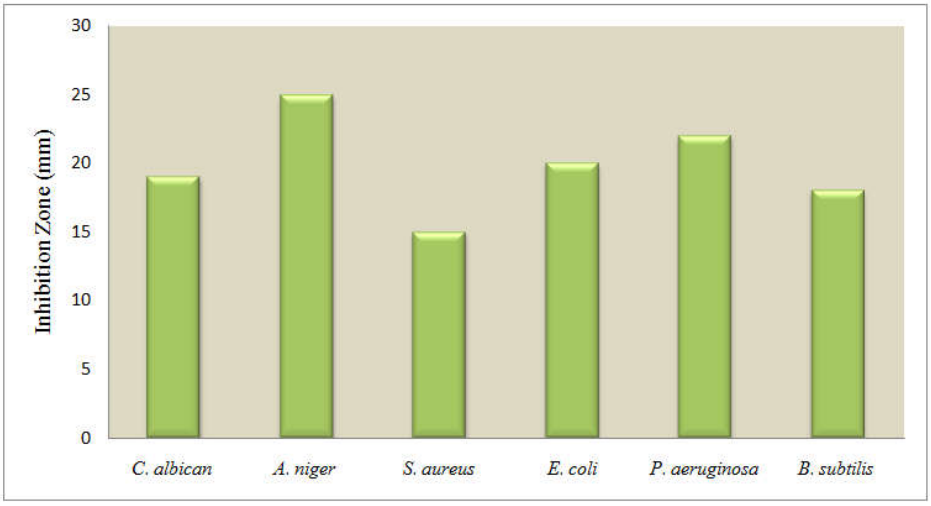

Figure 1. The Antimicrobial Activity of *A. seyal* Stem Dry Distillate

Table 3. The Result of GC-MS of A. seyal Stem Distillate

Peak NO	R.T	M.W	Formula	Compound name	Area %
1	3.102	96	$C_5H_4O_2$	Furfural	7.15
2	3.236	74	C_3H_6S	Methylthiirane	0.13
3	3.317	98	$C_5H_6O_2$	Furfuralcohol	3.35
4	3.449			Unknown	0.76
5	3.628	130	$C_7H_{14}O_2$	4-Methylhexanoic acid	0.12
6	3.836	132	$C_6H_{12}O_3$	2-(Tetrahydrofuran-2-yloxy)-ethanol	0.11
7	3.915	119	$C_4H_9NO_3$	dl-Threonine	0.64
8	3.991	96	C_6H_8O	2-Ethylfurane	1.15
9	4.045	110	$C_6H_6O_2$	2-Acetylfuran	0.66
10	4.088	84	C_5H_8O	Dumasin	1.51
11	4.134	98	$C_6H_{10}O$	2-Cyclohexenol	0.13
12	4.209	98	$C_5H_6O_2$	1,2-cyclopentanedione	1.28
13	4.245	142	$C_8H_{14}O_2$	β-Octalactone	0.12
14	4.332	107	C_7H_9N	3,5-Lutidine	0.14
15	4.365	96	C_6H_8O	2-Cyclohexenone	0.09
16	4.427	264	$C_{19}H_{20}O$	6-Methyl-2,2-diphenyl-cyclohexanone	0.42
17	4.533	112	$C_7H_{12}O$	Suberone	0.23
18	4.640	100	$C_5H_8O_2$	Valerolactone	0.08
19	4.694	174	$C_8H_{14}O_4$	Ethylene dipropionate	0.42
20	4.740	130	$C_6H_{10}O_3$	γ-Ethoxybutyrolactone	0.16
21	4.770	110	$C_6H_6O_2$	5-methylfurfural	0.46
22	4.805	96	C_6H_8O	3-Methyl-2-cyclopentenone	1.03
23	4.893	116	$C_6H_{12}O_2$	Hexanoic acid	0.08

Continue……

24	4.936	126	$C_6H_6O_3$	Methyl 2-furoate	0.09
25	4.975	94	C_6H_6O	Phenol	2.73
26	5.088	115	$C_4H_5NO_3$	Maleamic acid	0.12
27	5.137	102	$C_4H_6O_3$	2-Hydroxy-γbutyrolactone	0.44
28	5.221	110	$C_7H_{10}O$	3,4-dimethylcyclopent-2-en-1-one	0.21
29	5.289	171	$C_{10}H_{21}NO$	Decylamide	0.82
30	5.329	112	$C_6H_8O_2$	3,5-Dimethyl-2(5H)-furanone	0.51
31	5.400	102	$C_5H_{10}O_2$	Tetrahydro, furfuryl alcohol	0.81
32	5.515	244	$C_9H_{12}N_2O_6$	Uridine	0.33
33	5.651	128	$C_8H_{16}O$	4-methyl-4-Hepten-3-ol	0.27
34	5.724	112	$C_6H_8O_2$	3-Methyl-1,2-cyclopentanedione	3.24
35	5.864	124	$C_8H_{12}O$	2,3,4,5-Tetramethylfuran	0.12
36	5.927	110	$C_7H_{10}O$	2,3-dimethyl-2-cyclopentenone	0.99
37	6.002	98	$C_5H_6O_2$	4-Methyl-2(5H)-furanone	0.22
38	6.103	108	C_7H_8O	Orthocresol	0.98
39	6.150	126	$C_7H_{10}O_2$	3-Ethyl-2-hydroxy-2-cyclopenten-1-one	0.30
40	6.226	109	C_6H_7NO	2-Acetylpyrrole	0.09
41	6.281	156	$C_{10}H_{20}O$	2-Hexyltetrahydrofuran	0.45
42	6.361	130	$C_7H_{14}O_2$	Heptanoic acid	0.21
43	6.414	108	C_7H_8O	3-Cresol	2.11
44	6.489	128	$C_8H_{16}O$	Octanal	0.32
45	6.598	212	$C_{13}H_{24}O_2$	γ-tridecalactone	0.06
46	6.640	187	$C_9H_{17}NO_3$	15-Amino-1-pentanol, N,O-diacetyl-	0.09
47	6.707	124	$C_7H_8O_2$	Mequinol	4.81
48	6.783	126	$C_8H_{14}O$	2-Octenal	1.56
49	6.876	95	C_5H_5NO	4-Pyridinol	1.31
50	6.960	122	$C_8H_{10}O$	2,6-Dimethylphenol	0.22
51	7.064	126	$C_6H_6O_3$	Maltol	0.53
52	7.153	168	$C_{11}H_{20}O$	2-Isopropyl-2,5-dimethyl-cyclohexanone	0.95
53	7.382	124	C_9H_{16}	Cyclohexane	0.23
54	7.571	122	$C_8H_{10}O$	p-Xylenol	0.92
55	7.685	174	$C_6H_{10}N_2O_4$	Diethyl azodicarboxylate	0.28
56	7.758	122	$C_7H_6O_2$	Benzoic acid	0.12
57	7.832	144	$C_8H_{16}O_2$	Octanoic acid	0.46
58	7.866	179	$C_{10}H_{13}NO_2$	Meobal	0.56
59	8.031	122	$C_8H_{10}O$	Phenylethyl Alcohol	0.08
60	8.088	138	$C_8H_{10}O_2$	Creosol	0.24
61	8.230	116	$C_5H_8O_3$	Tetrahydro-2-Furancarboxylic acid	0.92
62	8.332	110	$C_6H_6O_2$	Catechol	7.11
63	8.567	144	$C_6H_8O_4$	3-Hexenedioic acid, trans-	1.15
64	8.625	152	$C_8H_8O_3$	methyl salicylate	0.07
65	8.783	126	$C_7H_{10}S$	Thiophene,2-propyl	0.24
66	8.849	144	$C_6H_8O_4$	DL-Lactide	0.53
67	8.945	152	$C_{10}H_{16}O$	Camphor	0.20
68	9.123	138	$C_9H_{14}O$	Phorone	0.09
69	9.172	290	$C_{12}H_{18}O_8$	Threitol, acetylated	0.09
70	9.282	124	$C_7H_8O_2$	2-Methyl hydroquinone	0.57
71	9.356	140	$C_7H_8O_3$	3-Methoxycatechol	1.80
72	9.440	110	$C_6H_6O_2$	Hydroquinone	1.03
73	9.600	152	$C_9H_{12}O_2$	4-Ethylguaiacol	1.21
74	9.703	124	$C_7H_8O_2$	Orcinol	1.56
75	9.789	128	$C_6H_8O_3$	Solerone	7.27
76	9.876	144	$C_6H_8O_4$	Lactide	0.20
77	10.121	150	$C_9H_{10}O_2$	4-Vinylguaiacol	0.68
78	10.249	146	$C_8H_{18}O_2$	4-Butoxy -1-butanol	0.23
79	10.484	124	$C_7H_8O_2$	4-Methylcatechol	0.87
80	10.558	154	$C_9H_{14}S$	Propylthiophene	0.19
81	10.646	154	$C_8H_{10}O_3$	Syringol	5.56
82	10.740	164	$C_{10}H_{12}O_2$	Eugenol	0.14
83	10.796	179	$C_{10}H_{13}NO_2$	3,4-Dimethoxyphenol	032
84	10.876	166	$C_{10}H_{14}O_2$	Dihydroeugenol	0.26
85	10.975	294	$C_{20}H_{38}O$	3,7,11,15-Tetramethyl-1-hexadecyn-3-ol	0.08
86	11.052	138	$C_8H_{10}O_2$	4-Ethylcatechol	0.68
87	11.233	136	$C_9H_{12}O$	2,3,5-Trimethylphenol	0.07
88	11.285	140	C_7H_8OS	4-Methoxythiophenol	0.14
89	11.357	152	$C_8H_8O_3$	Vanillin	0.43
90	11.462	164	$C_{10}H_{12}O_2$	Isoeugenol	0.16
91	11.527	224	$C_{14}H_{24}O_2$	Sinenofuranol	0.18
92	11.626	138	$C_{10}H_{18}$	1-Decyne	0.27
93	11.965	168	$C_9H_{12}O_3$	Homovanillyl alcohol	2.56
94	12.027	164	$C_{10}H_{12}O_2$	Trans-Isoeugenol	0.91
95	12.544	180	$C_6H_{12}O_6$	Allo-Inositol	4.86
96	13.017	182	$C_{10}H_{14}O_3$	5-tert-Butylpyrogallol	1.71
97	13.121	180	$C_{10}H_{12}O_3$	4-vinylsyringol	1.10
98	13.216	162	$C_6H_{10}O_5$	1,2-Anhydro-3,4,5,6-alloinositol	0.84
99	13.347	200	$C_{12}H_{24}O_2$	Dodecanoic acid	1.09
100	13.557	180	$C_{10}H_{12}O_3$	4-vinyl-2,6-dimethoxyphenol	1.34

Contine……..

101	13.857	180	$C_{11}H_{16}O_2$	Amol	0.05
102	13.935			Unknown	0.48
103	14.106	194	$C_{10}H_{10}O_4$	3-Hydroxy-4-methoxycinnamic acid	0.40
104	14.204	226	$C_{12}H_{18}O_4$	Senkyunolide J	0.32
105	14.544	160	$C_8H_{16}OS$	3-sulfanylheptanal	0.21
106	14.910	194	$C_{11}H_{14}O_3$	Methoxyeugenol	0.71
107	15.095	182	$C_9H_{10}O_4$	Syringaldehyde;	0.38
108	15.390	210	$C_{11}H_{14}O_4$	3,4,5-Trimethoxyacetophenone	0.20
109	15.599	270	$C_{17}H_{34}O_2$	Heptadecanoic acid	0.06
110	15.713	-	-	Unknown	1.14
111	15.980	-	-	Unknown	0.16
112	16.225	196	$C_{10}H_{12}O_4$	Xanthoxylin	0.81
113	16.382	228	$C_{14}H_{28}O_2$	Tetradecanoic acid	0.66
114	16.721	212	$C_{10}H_{12}O_5$	Homosyringic acid	1.80
115	16.806	284	$C_{19}H_{40}O$	Nonadecanol	0.05
116	17.314	-	-	Unknown	0.50
117	17.399	-	-	Unknown	0.19
118	17.828	134	$C_{10}H_{14}$	Cymol	0.27
119	18.146	168	$C_9H_{12}O_3$	2,4-Dimethoxybenzyl alcohol	0.12
120	18.284	234	$C_{14}H_{22}N_2O$	Lidocaine	0.18
121	18.337	270	$C_{17}H_{34}O_2$	Hexadecanoic acid	0.09
122	18.700	-	-	Unknown	1.57

The dry distillate of *A. seyal* stem prepared by dry distillation method was pale brown in colour, soluble in water with aromatic characteristic odour. The distillate yield was found to be 15% (v/w) and 83.87% (w/w), its specific gravity, refractive index, acid value and saponification value was found to be 0.95g, 1.341, 23.6 ml/g and 50.9 ml/g respectively. These findings are reported for the first time about the percentage content and physiochemical properties of the *A. seyal* stem oily dry distillate. The antioxidant activity of *A. seyal* stem dry distillate, evaluated by DPPH radical scavenging assay, showed potent antioxidant activity; the activity was found to be higher (94±0.01%) than the standard antioxidant drug agent (90±0.01). These finding was reported for the first time about the antioxidant activity of the plant dry distillate and it compatible with the current literature about the antioxidant activity of the volatile oil (Olivera *et al*., 2006; Milene *et al*., 2013) and justified the traditional use of the plant stem distillate (*Dokhan*) for the medicinal claims. The result of antimicrobial activity of oily dry distillate of *A. seyal* stem against four bacteria (Staphylococcus *aureus*, *Escherichia coli*, Pseudomonas aeruginosa, *Bacillus subtilis*) and two fungi (Candida albicans, and *Aspergillus niger*) are reported in Table 2 and Figure 1. The remarkable antibacterial and antifungal activity with the inhibition zone range of 15-25mm were shown. The MIC range against organisms was found to be 12.5–6.25µl. The distillate was found to be highly active against *Candida albicans*, the principal causative agent of the candidiasis, a fungal yeast infection affected the genital, skin, throat, mouth and blood (Sanogo *et al*., 1998). Vaginal yeast infections and urinary tract infections are very common in women and are mainly caused by Candida albicans (http://www.cdc.gov/fungal/diseases/candidiasis/genital/statistics.htm; Types of Vaginal Infections _ Everyday Health.htm). The distillate showed high activity against S**.** *aureus*, the predominant aerobes agent of UTIs infections (Soper *et al*., 1994; Ross *et al*., 2006). *B. subtilis* and *E. coli* are the commonest anaerobes Gram-negative agents of UTIs infections (Brook, 1990), *E. coli* cause more than 90% urinary tract infections (http://www.Urinary Tract Infections.htm). Pseudomonas aeruginosa was reported as one agent of UTIs (http://www.Urinary Tract Infection _ Everyday). A wide range of infections, from relatively minor skin infections to more serious infections of lungs were reported to be cause by *S. aureus*, it is a one of the commonest bacterial agents in the skin and soft tissue infections (Jawetz *et al*., 1978; Adeleye *et al*., 2003), wounds infectious (Mann *et al*., 2008), it responsible for the respiratory infections (Sanogo *et al*., 1998). It is a human bacterial pathogen causing dental caries and periodontal disease (Akande and Hayashi, 1998; Taiwo *et al*., 1999). *C. albicans* and *A. niger* were reported to cause superficial fungal infections of skin, (Jawetz *et al*., 1978) *A. niger* is one of the agents cause respiratory tract infection (Jawetz *et al*., 1978). *E. coli* is the main agent responsible for diarrhea (Public health agency of Canada, 2014; Zumbes *et al*., 2007). *P. aeruginosa* is an organism responsible for opportunistic infections, such as respiratory tract inflammations (Mann *et al*., 2009). These high activity of the dry distillate (D*okhan*) against six tested organisms justified the traditional use of D*okhan* by Sudanese women for the treatment of candidiasis, genital infections, urinary tract infections, severe stomach cramps, diarrhea, vomiting, respiratory tract and throat infection, for toothache, and for wound and skin infection, the result justified the use of stem as chewing sticks for teeth cleaning and oral hygiene. These finding about the antimicrobial activity of the plant dry distillate was reported for the first time. The result was compatible with the current literature about the antimicrobial activity of the volatile oil (Shigeharu *et al*., 2001; Hammer *et al*., 1999; Imaël *et al*., 2012). The result of GC-MS analysis of the oily dry distillate of *A. seyal* stem was shown in Figure 2 and Table 3. The identification of these constituents was made by the direct comparison of their retention times, peak areas molecular weight, formula and mass spectra fragmentation pattern with those in the NIST library (http://webbook.nist.gov/chemistry /NIST Standard Reference Database 69: NIST Chemistry WebBook). One hundred and twenty two constituents were detected. Among these constituents, the major constituents are Solerone (7.27), furfural (7.15%), catechol (7.11%), Syringol (5.56%), Allo-Inositol (4.86), Mequinol (4.81%) and Furfuralcohol (3.35), beside other hydrocarbon and fatty acid derivative. These findings about the chemical composition of *A. seyal* stem dry distillate are reported for the first time. The analysis revealed the presence of many nitrogenous compounds which are compatible with the chemistry of the Fabaceae family (British Pharmacopoei, 2002).

Conclusion

The study conclude that, *A. seyal* stem dry distillate posses potent antioxidant and antimicrobial activities justified the widely use of the stem *Dokhan* in Sudanese traditional medicine for the treatment of candidiasis, genital yeast

infection, urinary tract infection, severe stomach cramps, diarrhea and vomiting, respiratory tract disease, cold and throat infection, wound and skin infection and toothache.

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