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PHYTOCHEMICAL INVESTIGATION OF CHLOROFORM EXTRACT FROM ROOT, STEM AND LEAF OF *ADENOCALYMMA IMPERATORIS-MAXIMILIANII* (WAWRA) L.G. LOHMAM (BIGNONIACEAE)

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ABSTRACT

The Bignoniaceae family has 110 genera and approximately 650 species, widely distributed in tropical regions. Among the genera of this family, the *Adenocalymma* (75 species) have been little investigated from a phytochemical point of view, found only ethnobotanical reports. The aim of this study was the phytochemical characterization of chloroform extracts from the vegetative parts (root, stem and leaves) of *Adenocalymma imperatoris-maximilianii* (Wawra) L.G. Lohmann using analysis by GC-MS. Seventy-one secondary metabolites were identified in chloroform extracts of the root, eleven compounds were detected in stems and seventeen were found in the leaves. There was evidence of neophytadiene in the vegetative parts of this species. Five compounds were common only to stem and leaf extracts. In the root extract, we observed compounds belonging to the alkaloid class. Due to the importance and the various biological activities described in the literature on compounds identified in this study *A. imperatoris-maximilianii* can be considered an alternative source of bioactive secondary metabolites for pharmaceutical therapy.

KEYWORDS: **Bignoniaceae, *Adenocalymma imperatoris-maximilianii*, vegetative parts, chloroform extract, GC-MS.**

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INTRODUCTION

Bignoniaceae is a very important economic family, and ethnobotany studies report 36 genera which are used in folk medicine. Of these, twenty-seven are vines and nine are trees[1]. The family comprises 110 genera and about 650 species, widely distributed in tropical regions around the world, especially in the American tropics[2]. The number of species of Bignoniaceae adapted to temperate regions has grown significantly in North America and East Asia. Although considered a small botanical family, it has attracted attention of researchers in recent decades due to its inherent bioactive constituents described in the literature. This family, because of its biological and pharmacological effects, is used in traditional medicinal systems of different countries, where people and practitioners use a number of species for the treatment of several diseases[2]. Bignoniaceae is distinguished from other botanical families by the common occurrence of secondary metabolites, such as iridoids, alkaloids and iridoid glycosides, quinones and anthraquinones, complex esters and diphenolic *O*-glycosides, tannins, flavonoids, anthocyanins and carotenoids[3]. The Bignoniaceae family is a promising source of chemical constituents which has been little explored. However, the isolation of lapachol and recognition of its activities: cytostatic, bacteriostatic, antifungal, cercaricidal, trypanocidal and antipyretic, and their biosynthetic chemo-pharmaceutical properties have increased the pharmacological interest in the species of this family[4]. As for the chemical constituents of the genus *Adenocalymma*, there are about 75 species, most of these requiring pharmacognostic studies, since many of them have only undergone ethnobotanical studies[3]. As an example of the few species studied of the genus *Adenocalymma* were analyzed as to their phytochemical and pharmacological properties, there is: *Adenocalymma nodosum* (Silva Manso) L.G. Lohmann, having the following classes of secondary metabolites: flavonoids and saponins in the roots, saponins, flavonoids and essential oil in the leaves, with the main components being benzaldehyde and 1-octen- 3-ol[5,6]. Preliminary studies of *Adenocalymma peregrinum* (Miers) L.G. Lohmann, identified the following classes of secondary metabolites: flavonoids, carbohydrates and iridoid glycosides saponins. The two species showed the following biological activities: antimicrobial, anti-inflammatory as well as against scab[5,6,7].

The species *Adenocalymma imperatoris-maximilianii* (Wawra) L.G. Lohmann is found in northeastern Brazil, distributed the throughout the states of Maranhão, Piauí, Ceará, Pernambuco, Paraíba and Bahia, where it is commonly known as "vine basket"[8]. The plant species spreads quickly over surrounding plants, producing blooms in its natural habitat, usually in the months from December to February. *A. imperatoris-maximilianii* has several synonyms: *Bignonia imperatoris-maximilianii* Wawra; *Pleonotoma Imperatoris-maximillianii* (Wawra) Bureau & K. Schum; *Memora imperatoris-maximillianii* (Wawra) A.H. Gentry, *Memora cristicalix* A.H. Gentry[9]. Etnobotanical data reports from areas where this plant is commonly harvested refer to its use decocted in alcohol to treat bacterial skin diseases or as food for animals, especially goats. Most Brazilian native plants do not have studies that allow the development of complete and up-to-date studies. Many species are used empirically without scientific support for their efficacy and safety, which shows that in a country like Brazil, with enormous biodiversity, there is a large gap between the supply of plants and research studies available on them. Given the above, *A. imperatoris maximilianii*, fits this scenario, as we found no reports or studies of its phytochemical or biological activities in the specialized literature. The objective of this study was to analyze the bioactive compounds by GC-MS of the chloroform extract of the root, stem and leaf of *A. imperatoris-maximilianii*, hoping to contribute to the knowledge of existing majoritarian secondary metabolites in this species.

MATERIALS AND METHODS

(i) Botanical Material

A. imperatoris-maximilianii (Bignoniaceae) was collected in the municipality of Pombos, state of Pernambuco, Northeast of Brazil (Coordinates: 80° 7' 33" S, 350° 21' 14" W). The plant material was identified by botanist Rita de Cássia A. P. Galindo. A voucher specimen was deposited in the Herbarium Dárdano de Andrade Lima, Instituto Agronômico de Pernambuco (IPA), and assigned the number IPA - n. 84012.

(ii) Obtaining the partitions

Root, stem and leaf of *A. imperatoris-maximilianii*, were ground in a Willey mill and then 40 mg of the material was subjected to extraction using 2 mL of chloroform (HPLC grade - Merck) for 30 minutes in an ultrasonic bath (Unique brand, model USC-1400). The samples were evaporated in an N_2 gas dryer and 2 mg of the extracts were dissolved in 2 mL of ethyl acetate for analysis with gas chromatography coupled to mass spectroscopy (GC-MS).

(iii) CG-MS analysis

The chloroform extracts of root, stem and leaf were analyzed by gas chromatography-mass spectrometry (GC-MS) using a Shimadzu GCMS model QP2010 instrument in a system operated by electron impact (70 eV) and the injector temperature was set at 260 °C with a split ratio of 1:5. The DB5-MS column [30 m × 0.25 mm i.d., film thickness 0.25 µm (5% cross-linked phenyl-methylpolysiloxane)] was used (Agilent J & W GC Columns), with helium as the carrier gas, a column flow of 1.3 mL/min, an injection volume of 1 µL, the injector temperature at 260 °C and pressure of 97.4 kPa. A mixture of (C_9-C_{20}, C_{21}-C_{40}) linear hydrocarbons was injected under the same conditions to identify the components. The spectra obtained were compared with the equipment database (FFNSC1.3.lib, WILEY7.LIB, NIST08s.LIB, MY LIBRARY.lib).

RESULTS AND DISCUSSION

The GC-MS chromatogram of the chloroform extract of the root of *A. imperatoris-maximilianii* has seventy-one peaks (Fig. 1), corresponding to presence of the seventy-one compounds (Table 1), whose structures have been proposed by the four libraries of the instrument (FFNSC1.3.lib, WILEY7. LIB, NIST08s.LIB, MY LIBRARY.lib). The compounds that showed the greater areas (%) were: 2-pentanone, 4,4-dimethyl (22.48%); methyl palmitate (6.72%); octadeca acid-9,12-dienoic acid methyl ester (4.98%), 1,2-benzenedicarboxylic acid, bis(2-ethylhexyl) ester (14.29%) and stigmast-5-en-3β-ol (5.63%). The GC-MS chromatogram of the chloroform extract of the stems *A. imperatoris-maximilianii* showed eleven peaks (Figure 2), which corresponds to the structures that have been proposed by the four libraries of the instrument (Table 2). The compounds which had the greater areas (%) were: squalene (48.07%), stigmasterol (5.75%); stigmast-5-en-3β-ol (31.46%); lupenone (6.98%) and lupeol (36.13%). The third extract analyzed by GC-MS was the chloroform extract of the leaves, which chromatogram showed seventeen peaks (Figure 3), corresponding to the seventeen secondary metabolites whose structures have been proposed by the four libraries of the instrument (Table 3). Compounds that had the greatest areas (%) were: neophytadiene (10.29%), vitamin E (10.16%), stigmasterol (7.98%) and β-sitosterol (40.93%). Neophytadiene was identified in all vegetative parts of *A. imperatoris-maximilianii* (root, stem and leaf). This compound has the following biological activities: antipyretic, analgesic, anti-inflammatory, antimicrobial and antioxidant[10]. The chloroform extracts of the leaves and stems of *A. imperatoris maximilianii* presented the same secondary metabolites: squalene, γ-tocopherol, vitamin E, β-amyrin and stigmasterol, as shown in Table 4. Ten peaks in the chromatogram were detected by GC-MS of the chloroform extract of the root of *A. imperatoris-maximilianii*, thus identifying ten compounds belonging to the class of alkaloids: 1-methyl-2-pyrrolidinone;

pyrrolidinone; 1-methyl-2,5-pyrrolidinedione; 2-methyl-piperidin-4-ol; 1,3-dinitro imidazolidine; 5-isopropyl-2,4-imidazolidinedione; 2-amino-7-chloro-2-methyl-heptanoic acid; 2-*t*-butyl-5-hydroxymethyl-4-oxazoline-3-carboxylic; l-norleucine, 2-Methoxycarbonylamino-hexanoic acid decyl ester; 3-Thioxo-3,4-dihydro-2*H*[1,2,4]triazin-5-one .

Figure 1

GC-MS chromatogram of the chloroform extract of the roots of A. imperatoris-maximilianii.

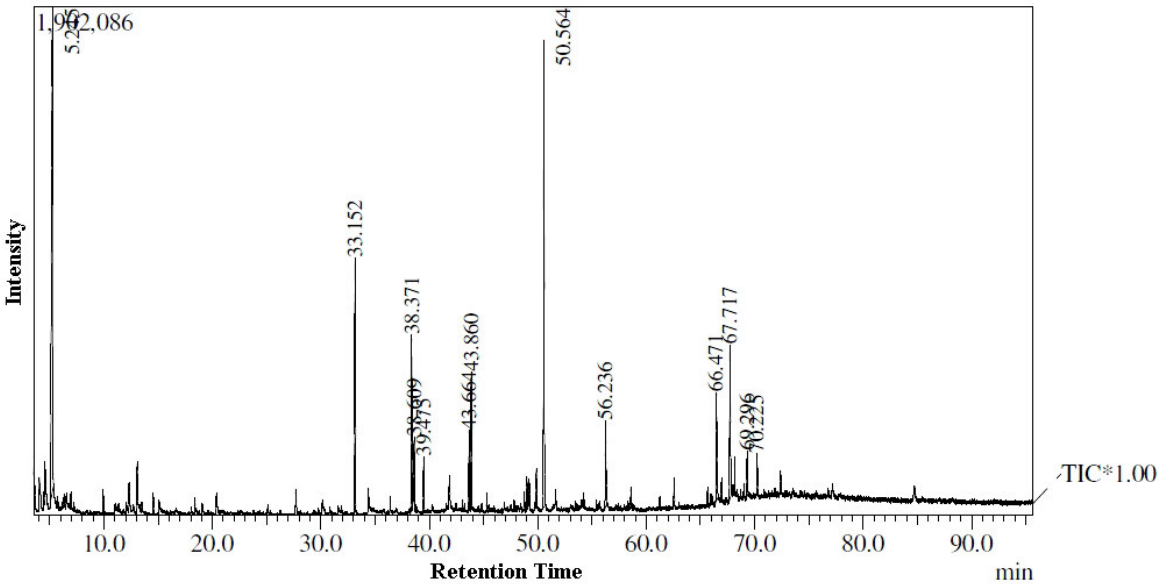

Table 1

Compounds identified in the chloroform extract of the roots of A. imperatoris-maximilianii by GC-MS.

Peak	Retention time (min)	Peak area (%)	Compounds	Molecular weight	Molecular formula
1	3.546	0.98	2-chloro-2,3-dimethyl-butane	120	$C_6H_{13}Cl$
2	3.590	0.51	1-methyl-pyrrolidin-2-one	99	C_5H_9NO
3	4.032	0.71	Pyrrolidin-2-one	85	C_4H_7NO
4	4.155	0.55	Cyclopenecarboxylic- acid 2-methoxy-ethyl-ester	172	$C_9H_{16}O_3$
5	4.444	0.33	1-Methyl-pyrrolidine-2,5-dione	113	$C_5H_7NO_2$
6	4.535	0.57	Succinic acid monomethyl ester	132	$C_5H_8O_4$
7	5.055	0.18	2-hydroxy-succinic acid dimethyl ester	162	$C_6H_{10}O_5$
8	5.245	22.48	4,4-dimethyl-2-pentanona	114	$C_7H_{14}O$
9	5.739	0.24	Pentyl formate	116	$C_6H_{12}O_2$
10	6.329	0.28	Trimethylsilyl 5-methoxypentanoate	204	$C_9H_{20}O_3Si$
11	6.530	0.30	2-Methyl-piperidin-4-ol	115	$C_6H_{13}NO$
12	6.585	0.09	1,3-Dinitro imidazolidine	162	$C_3H_6N_4O_4$
13	6.946	0.35	5-isopropyl-imidazolidine-2,4-dione	142	$C_6H_{10}N_2O_2$
14	7.215	0.18	2,3-Dihydroxy-succinic acid dimethyl ester	178	$C_6H_{10}O_6$
15	9.933	0.66	2-Amino-7-choro-2-methyl-heptanoic acid	193	$C_8H_{16}ClNO_2$
16	11.009	0.16	Acetic acid sec-butyl ester	130	$C_7H_{14}O_2$
17	11.352	0.17	3,4,5-Trimethoxy-tetrahydro-pyran-2-ol	192	$C_8H_{16}O_5$
18	12.329	0.68	1-(4-Methoxy-phenyl)-ethanone	150	$C_9H_{10}O_2$
19	13.068	1.39	4-Methoxy-benzoic acid methyl ester	166	$C_9H_{10}O_3$
20	14.540	0.44	2-tert-Butyl-5-hydroxym ethyl-oxazole-3-carboxylic acid methyl ester	215	$C_{10}H_{17}NO_4$
21	18.379	0.29	4-Hidroxy-3-methoxy-benzoic acid methyl	182	$C_9H_{10}O_4$

			acid ester		
22	18.430	0.02	1-(2-chloro-ethoxy)propane	122	$C_5H_{10}O_4$
23	19.065	0.25	2-Methoxycarbonylamino-hexanoic acid decyl ester	329	$C_{18}H_{35}NO_4$
24	20.369	0.42	Allyl-cyclopentyloxy-dimethyl-silane	184	$C_{10}H_{20}OSi$
25	20.410	0.04	Propane, 1,3-dimethoxy-2-(methoxymethyl)-2-methyl-	162	$C_8H_{18}O_3$
26	20.425	0.03	3-Thioxo-3,4-dihydro-2*H*[1,2,4]triazin-5-one	129	$C_3H_3N_3OS$
27	27.690	0.62	4-Hydroxy-3,5-dimethoxy-benzoic acid hydrazide	172	$C_{10}H_{20}O_2$
28	27.745	0.03	4-Methyl-1-(5-methyl-2,3,4,5-tetrahydro-[2,3']bifuranyl-5-yl)-pentan-2-one	250	$C_{15}H_{22}O_3$
29	27.770	0.05	Chloro-acetic acid *tert*-butyl ester	150	$C_6H_{11}ClO_2$
30	30.136	0.58	7,11,15-trimethyl-3-methylene-hexadec-1-ene	278	$C_{20}H_{38}$
31	30.240	0.03	1,3,3-Trimethyl-bicyclo[2.2.1]heptan-2-one	152	$C_{10}H_{16}O$
32	33.152	6.72	Hexandecanoic acid methyl ester	270	$C_{17}H_{34}O_2$
33	34.394	0.76	*Hexadecanoic acid*	256	$C_{16}H_{32}O_2$
34	36.385	0.38	Heptadecanoic acid methyl ester	270	$C_{17}H_{34}O_2$
35	38.371	4.98	Octadeca-9,12-dienoic acid methyl ester	294	$C_{19}H_{34}O_2$
36	38.540	0.80	Octadeca-9,12,15-trienoic acid methyl ester	292	$C_{19}H_{32}O_2$
37	38.609	2.17	Octadeca-2,11-dienoic acid methyl ester	296	$C_{19}H_{36}O_2$
38	38.788	0.10	3-cyclohexylpropan-1-ol	142	$C_9H_{18}O$
39	38.830	0.05	Trimethyl-[(E)-tetradeo-7-enoxy]silane	384	$C_{17}H_{36}OSi$
40	39.475	1.49	Octadecanoic acid methyl ester	298	$C_{19}H_{38}O_2$
41	40.195	0.02	3-Methyl-but-2-enoic acid phenyl ester	176	$C_{11}H_{18}O_2$
42	40.238	0.29	2-(2-formylbenzoyl)benzaldehyde	278	$C_{15}H_{10}O_3$
43	41.842	1.01	Dodecanoic acid 2,3-dihydroxy-propyl ester	274	$C_{15}H_{30}O_4$
44	41.965	0.04	Pentanoic acid-cyclopentyl-ethyl ester	198	$C_{12}H_{22}O_2$
45	42.463	0.08	Methyl 5-(2undecylcopropyl)pentanoate	310	$C_{20}H_{38}O_2$
46	42.475	0.02	(2,2,3,3-Tetramethyl-cyclopropyl)-methanol	128	$C_8H_{16}O$
47	43.090	0.21	3-Acetoxy-3-butoxycarbonyl-pentanedioic acid dibutyl ester	402	$C_{20}H_{34}O_8$
48	43.200	0.02	1-Chloromethyl-1-(2,2-dimethl-propoxy)-silinane	234	$C_{11}H_{23}ClOSi$
49	43.664	2.13	Icosanoic acid 1-acetoxymethyl-2-hydroxy-ethhyl ester	470	$C_{27}H_{50}O_6$
50	43.860	3.98	2-(2,3-Diacetoxy-propyl)-hexadecanoic acid anion	414	$C_{23}H_{42}O_6$
51	45.304	0.47	Icosanoic acid methyl ester	470	$C_{27}H_{50}O_6$
52	45.460	0.01	2-Methyl-3-methylene-cyclopentanecarbaldehyde	124	$C_8H_{12}O$
53	47.831	0.19	4-(2-(2-[2-(2-Pentyl-cyclopropylmehyl)cyclopropylmethyl]-cyclopropylmethyl)cyclopropyl)butl acid methyl ester	374	$C_{25}H_{42}O_2$
54	48989	1.21	11-bicyclo [3.1.0]hex-2-yl-undecanoic acid methyl ester	280	$C_{18}H_{32}O_2$
55	49.215	1.07	2-(2,3-diacethoxy-propyl)tetradecanoic acid anion	386	$C_{21}H_{38}O_6$
56	49.695	0.24	6-acetoxy-4,5,7-trimethoxy-heptanoic acid anion	278	$C_{12}H_{22}O_7$
57	49.870	1.26	9,10-diachloro-octadecnoic acid methyl ester	366	$C_{19}H_{36}Cl_2O_2$
58	50.564	14.29	Bis(2-ethyllexyl)benzene-1,2dicarboxylate	390	$C_{24}H_{38}O_4$
59	51.650	0.40	1,1,4a-trimethyl-8-propan-2-yl-2,3,4,9,10,10a-hexahydrophenanthrene-2,7-diol	302	$C_{20}H_{30}O_2$
60	56.236	2.67	2(1H)-phenanthrenone,3,4,4a,9,10,10a,-hexahydro-1,1,4a, -trimethyl	242	$C_{17}H_{22}O$
61	56.305	1.04	6 beta,6.beta.-Dibromo-6,7-methylenetestosterone	456	$C_{20}H_{26}Br_2O_2$
62	58.576	0.32	3,6,9-Trimethyl-2,7-dioxo-2,3,3a,4,5,7,9a,9b-octahydroazuleno[4,5-b]furan-2,7-dione	304	$C_{17}H_{20}O_5$
63	62.567	0.64	Cholesta-4,6-dien-3-ol, benzoate, (3,beta.)-	488	$C_{34}H_{48}O_2$
64	65.650	0.40	Dodecanoic acid, 1,2,3-propanetriyl Ester	470	$C_{27}H_{50}O_6$

65	66.471	3.77	Stigmasta-5,22-dien-3-ol, (3.beta.,22E)-	412	$C_{29}H_{48}O$
66	66.939	0.46	Stigmasterol trimethylsilyl ether	484	$C_{38}H_{56}OSi$
67	67.717	5.63	Stigmast-5-en-3-ol,(3.beta.)-	414	$C_{29}H_{50}O$
68	68.148	0.87	Beta-sitosterol trimethylsilyl ether	486	$C_{32}H_{58}OSi$
69	69.296	1.63	Lupeol	426	$C_{30}H_{50}O$
70	70.225	1.13	Stigmast-4-en-3-one	412	$C_{29}H_{48}O$
71	72.384	0.84	7, beta-hydroxydiosgenin	430	$C_{27}H_{42}O_4$

Figure 2
***GC-MS chromatogram of the chloroform extract** from the stems of A. imperatoris-maximilianii.*

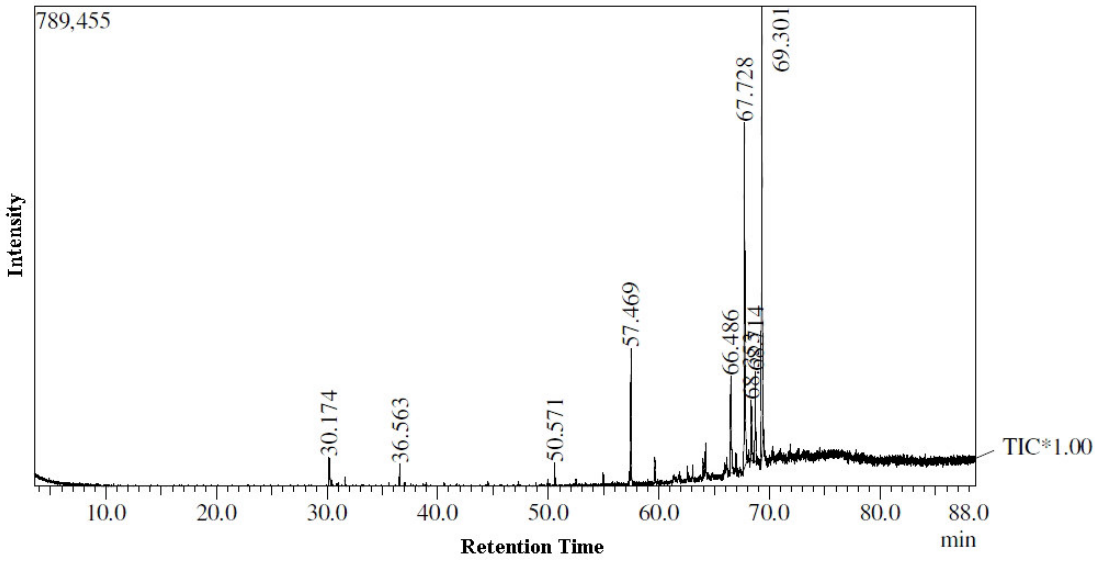

Table 2
Compounds identified in the chloroform extract from the stems of A. imperatoris-maximilianii by GC-MS.

Peak	Retention time (min)	Peak área (%)	Compounds	Molecular weight	Molecular formula
1	30.174	0.51	7,11,15-Trimethyl-3-methylene-hexadec-1-ene	278	$C_{20}H_{38}$
2	36.563	1.16	Kaur-16-ene	272	$C_{20}H_{32}$
3	50.571	1.20	bis(2-ethylhexyl) benzene-1,2-dicarboxylate	390	$C_{24}H_{38}O_4$
4	57.469	48.07	(6E,10E,14E,18E)-2,6,10,15,19,23-hexamethyltetracosa-2,6,10,14,18,22-hexaene	410	$C_{30}H_{5O}$
5	62.582	1.17	(2R)-2,7,8-Trimethyl-2-[(4R,8R)-4,8,12-trimethyltridecyl]-6-chromanol	416	$C_{28}H_{48}O_2$
6	64.210	2.06	2,5,7,8-tetramethyl-2-(4,8,12-trimethyltridecyl)-3,4-dihydrochromen-6-ol	430	$C_{29}H_{50}O_2$
7	66.486	5.75	(3S,8S,9S,10R,13R,14S,17R)-17-[(E,2R,5S)-5-ethyl-6-methylhept-3-en-2-yl]-10,13-dimethyl-2,3,4,7,8,9,11,12,14,15,16,17-dodecahydro-1H-cyclopenta[a]phenanthren-3-ol	412	$C_{29}H_{48}O$
8	67.728	31.46	Stigmast-5-en-3-ol, (3.beta.)-	414	$C_{29}H_{50}O$
9	68.353	5.53	(3S,4aR,6aR,6bS,8aR,12aR,14aR,14bR)-4,4,6a,6b,8a,11,11,14b-octamethyl-1,2,3,4a,5,6,7,8,9,10,12,12a,14,14a-tetradecahydropicen-3-ol	426	$C_{30}H_{48}O$
10	68.714	6.98	(1R,3aR,5aR,5bR,7aR,11aR,11bR,13aR,13bR)-3a,5a,5b,8,8,11a-hexamethyl-1-prop-1-en-2-yl-2,3,4,5,6,7,7a,10,11,11b,12,13,13a,13b-tetradecahydro-1H-cyclopenta[a]chrysen-9-one	424	$C_{30}H_{48}O$
11	69.301	36.13	(1R,3aR,5bR,7aR,9S,11aR,11bR,13aR,13bR)-3a,5a,5b,8,8,11a-hexamethyl-1-prop-1-en-2-yl-1,2,3,4,5,6,7,7a,9,10,11,11b,12,13,13a,13b-hexadecahydrocyclopenta[a]chrysen-9-ol	416	$C_{30}H_{50}O$

Figure 3
GC-MS chromatogram of the chloroform extract from the leaves of A. imperatoris-maximilianii.

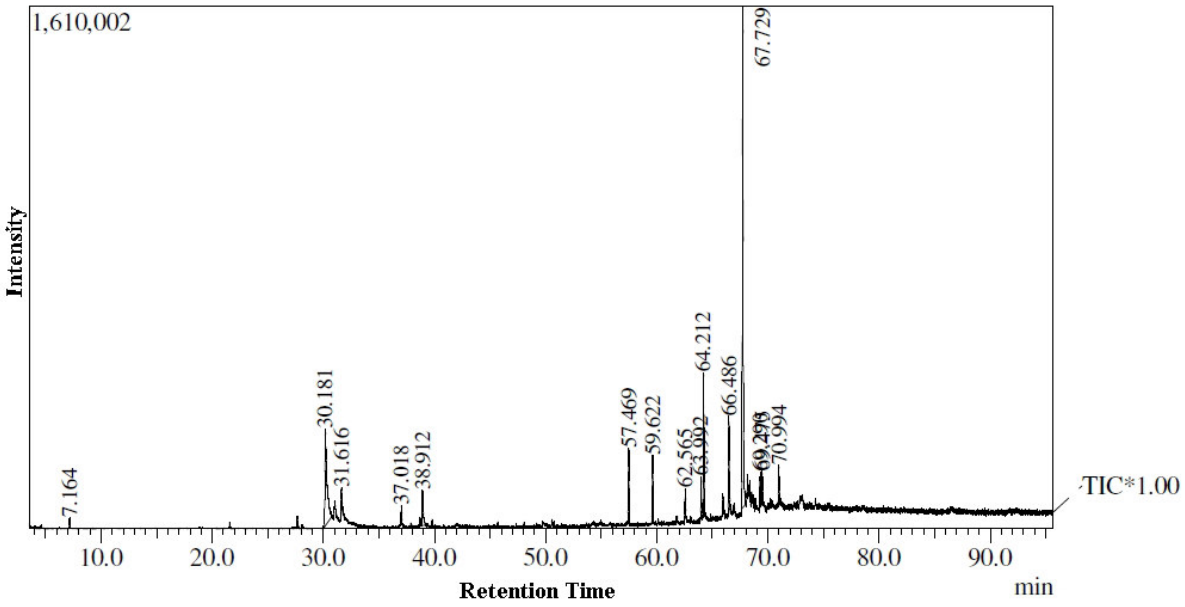

Table 3
Compounds identified in the chloroform extract from the leaves of A. imperatoris-maximilianii by GC-MS.

Peak	Retention time (min)	Peak área (%)	Compounds	Molecular weight	Molecular formula
1	7.164	0.58	2-bromo-1-chloro-propane	156	C_3H_6BrCl
2	30.181	10.29	7,11,15-Trimethyl-3-methylene-hexadec-1-ene	278	$C_{20}H_{38}$
3	30.340	0.18	Tridec-2-en-ol	198	$C_{13}H_{26}O$
4	37.018	1.05	trimethylsilyl hexadecanoate	328	$C_{19}H_{40}O_2Si$
5	38.665	0.02	trimethylsilyl (7Z)-7-trimethylsilyloxyiminooctanoate	317	$C_{14}H_{31}NO_3Si_2$
6	38.912	2.90	3,7,11,15-Tetramethyl-hexadec-2-en-1-o	297	$C_{20}H_{40}O$
7	57.469	4.86	2,6,10,15,19,23-Hexamethyl-tetracosa-2,6,10,14,18,22-hexaene	410	$C_{30}H_{50}$
8	59.622	3.94	Tetratetracontane	619	$C_{44}H_{90}$
9	62.565	2.03	2,6,10,15,19,23-Hexamethyl-tetracosa-2,6,10,14,18,22-hexaene	416	$C_{28}H_{48}O$
10	63.992	2.57	Nonacosane	408	$C_{29}H_{60}$
11	64.212	10.16	2,5,7,8-tetramethyl-2-(4,8,12-trimethyltridecyl)-3,4-dihydrochromen-6-ol	430	$C_{29}H_{50}O_2$
12	66.486	7.98	(3S,8S,9S,10R,13R,14S,17R)-17-[(E,2R,5S)-5-ethyl-6-methylhept-3-en-2-yl]-10,13-dimethyl-2,3,4,7,8,9,11,12,14,15,16,17-dodecahydro-1H-cyclopenta[a]phenanthren-3-ol	412	$C_{29}H_{48}O$
13	67.729	40.93	17--10,13-dimethyl-2,3,4,7,8,9,11,12,14,15,16,17-dodecahydro-1H-cyclopenta[a]phenanthren-3-ol	414	$C_{29}H_{50}O$
14	68.139	1.35	[17-(5-ethyl-6-methylheptan-2-yl)-10,13-dimethyl-2,3,4,7,8,9,11,12,14,15,16,17-dodecahydro-1H-cyclopenta[a]phenanthren-3-yl]oxy-trimethylsilane	486	$C_{32}H_{58}OSi$

15	69.290	2.79	2,6,10,15,19,23-Hexamethyl-tetracosa-2,6,10,14,18,22-hexaene	426	$C_{30}H_{50}O$
16	69.475	2.57	2-bromo-1-chloro-propane	426	$C_{30}H_{50}O$
17	70.994	3.46	7,11,15-Trimethyl-3-methylene-hexadec-1-ene	426	$C_{30}H_{50}O$

Table 4

Compounds identified in the chloroform extract of the stem and leaves Adenocalymma imperatoris-maximilianii with their biological activities.

Compounds Name	Biological Activity
Squalene	Neutralizes different xenobiotics, anti-inflammatory, anti-atherosclerotic and anti-neoplastic, has arole in skin aging and pathology, and Adjuvant activities.
Gamma-tocopherol	AntiCRP, Antiatherosclerotic, Anticancer, Antiinflammatory, Antioxidant, Antiprostaglandin, Antitumor, Cardioprotective, Cyclooxygenase-Inhibitor, Hypocholesterolemic, NO-Inhibitor , Natriuretic, PKC-Inhibitor.
Vitamin E	5-HETE-Inhibitor; Allergenic; Analgesic; Antiaggregant; Antiaging; Antialzheimera; Antianginal; Antiarteriosclerotic; Antiarthritic; Antiatherosclerotic; Antibronchitic; Anticancer; Anticariogenic; Anticataract; Antidecubitic; Antichorea; Anticoreic; Anticonvulsant; Anticoronary; Antidementia; Antidermatitic; Antiepitheleomic; Antidiabetic; Antifibrositic; Antidysmenorrheic; Antiinflammatory; Antiglycosation; Antiherpetic; Antiinfertility; Antiischemic; Antileukemic; Antileukotriene; Antilithic; Antimastalgic; AntiMD ; Antilupus; Antimaculitic; Antineuritic; Antimelanomic; AntiMS; Antimyoclonic; Antineuropathic; Antinitrosaminic; Antiophthalmic; Antioxidant; Antiosteoarthritic; AntiPMS; Antiproliferant; Antiparkinsonian; Antisenility; Antiradicular; Antiretinopathic; Antisterility; Antirheumatic; Antisickling; Antispasmodic; Antistroke; Antisunburn; Antisyndrome-X; Antithalassemic; Antithrombotic; Antithromboxane-B2; Antitoxemic; Antitumor; Antitumor (Breast); Antitumor (Colorectal); Antitumor (Prostate); Antitumor (Stomach); Antiulcerogenic; Apoptotic; Calcium-Antagonist; Cancer-Preventive; Cardioprotective; Cerebroprotective; Circulatory-Stimulant; Circulotonic; Immunomodulator;Hepatoprotective; Hypocholesterolemic; Hypoglycemic; Immunostimulant; Lipoxygenase-Inhibitor; NO-Inhibitor; Phospholipase-A2-Inhibitor; Ornithine-Decarboxylase-Inhibitor; P21-Inducer; Protein-Kinase-C-Inhibitor; Vasodilator.
Beta- amyrin	Analgesic, antiedemic, antiinflammatory, antinociceptive, antiulcer, gastroprotective, hepatoprotective, larvicide, mosquitocide.
Stigmasterol	Anti-inflammatory, inhibits tumor promotion, anti-HIV reverse transcriptase, anti-inflammatory.

Source: Dr. Duke's Phytochemical and Ethnobotanical Databases

CONCLUSION

In this study, using GC-MS analysis of chloroform extracts of root, leaf and stem of Adenocalymma Imperatoris-maximilianii, seventy-one compounds were detected in the root, eleven compounds in the stem and seventeen compounds in the leaves. Many of the compounds found in the vegetative parts of A. Imperatoris-maximilianii have proven to have antibacterial activity, as is the case neophytadiene, found in the root, stem and leaves, justifying the popular application of the plant held by the local people. Because of the wealth of compounds in the vegetative parts, especially in the root, we concluded that A. Imperatoris-maximilianii has important potential as a phytotherapic, being an alternative source of bioactive compounds that can be used for the treatment of various diseases. This justifies future studies to evaluate its different biological activities and toxicity.

REFERENCES

1. Lopes M.M.M, Carvalho-Okano R.M, Souza A.L, Paiva H.N, Crescimento de mudas de cipó-cravo (*Tynanthus fasciculatus* Miers), uma liana com potencial medicinal. Revista Árvore, 32 (2): 211-216, (2008).
2. Rahmatullah M, Samarrai W, Jahan R, Rahman S, Sharmin N, Miajee Z.U.M. E.U, Chowdhury M.H, Bari S, Jamal F,

Bashar A.B.M. A, Azad A.K, Ahsan S, An ethnomedicinal, pharmacological and phytochemical review of some Bignoniaceae family plants and a description of Bignoniaceae plants in folk medicinal uses in Bangladesh. Advances in Natural and Applied Sciences, 4 (3): 236-253, (2010).

3. Gentry A.H, A synopsis of Bignoniaceae ethnobotany and economic botany. Annals of the Missouri Botanical Garden, 79: 53-64, (1992).
4. Oliveira A.B, Raslan D.S, Miraglia M.C.M, Mesquita A.A.L, Zani C.L, Ferreira D.T, Maia J.G.S, Estrutura química e atividade biológica de naftoquinonas de Bignoniáceas brasileiras. Quim. Nova, 13 (4): 302-307, (1990).
5. Tresvenzol L.M.F, Queiroz D.C, Rezende R.C, Nascimento T.L, Rosa V.S, Paula J.R, Estudo Farmacognóstico da *Memora nodosa* (MANSO) MIERS. Revista Eletrônica de Farmácia, 2 (2): 221-223, (2005).
6. Tresvenzol L.M.F, Fiuza T.S, Pimenta F.C, Zatta D.T, Bara M.T.F, Ferri P.H, Lima A.B.M, Paula J.R, Composição química do óleo essencial e atividade antimicrobiana da *Memora nodosa* (Bignoniaceae). Latin American Journal of Pharmacy, 28 (4): 513-5199, (2009).
7. Grassi R.F, Resende U.M, Silva W, Macedo M.L.R, Butera A.P, Tulli E.O, Saffran F.P, Siqueira J.M, Estudo fitoquímico e avaliação alelopática de *Memora peregrina*–"ciganinha" – Bignoniaceae, uma espécie invasora de pastagens em Mato Grosso do Sul. Quimica Nova*,* 28 (2): 199-203, (2005).
8. Forzza, R.C, Catálogo de Plantas e Fungos do Brasil, Vol 1, Jardim Botânico do Rio de Janeiro publischer: 759, (2010).
9. Tropicos.org. Missouri Botanical Graden 2013 (Available online: 06Jan2014) <http://www.tropicos.org/Name/100141548>.
10. Dr. Duke's phytochemical and ethnobotanical databases [Online database]. (Available online: 17Jan 2014) http://www.ars-grin.gov/cgi-bin/duke/chem-activities.pl.
11. 11- Ashok, K.K, Vijayalakshmi, K. GC-MS Analysis of phytochemical constituents in ethanolic extract of *Punica granatum* peel and *Vitis vinifera* seeds. International Journal of Pharma and Bio Sciences, Vol. 2, Issue 4, Oct – Dec 2011.