XANTHONES AND AN ANTHRAQUINONE FROM STEM BARK AND ROOTS OF *CRATOXYLUM ARBORESCENS*

(Xanthon dan Antrakuinon daripada Kulit Batang dan Akar *Cratoxylum arborescens*)

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Abstract

Phytochemical studies were conducted on the stem bark and roots of *Cratoxylum arborescens* that has been collected from Post Brooke, Gua Musang, Kelantan, Malaysia. *Cratoxylum arborescens* has orange latex like iodin. The orange latex from stem bark could be found because of existing xanthones compounds. Extraction of the stem bark using organic solvents followed by extensive purification using standard procedure of purification yielded three known xanthones, pruniflorone H (1), cochinchinone C (2) and macluraxanthone (3). Employing the same procedure, an anthraquinone, vismiaquinone (4) was isolated from the roots of the plants. These four compounds were characterized by NMR spectral data using 1D and 2D-techniques and comparison with the literature data. The result of this studies suggested that xanthones are the main compounds of *Cratoxylum.*

Keywords: cochinchinone C, guttiferae, macluraxanthone, prunifolorone H, vismiaquinone

Abstrak

Kajian fitokimia yang dijalankan ke atas kulit batang dan akar *Cratoxylum arborescens* yang telah dikumpul dari Post Brooke, Gua Musang, Kelantan, Malaysia. *Cratoxylum arborescens* mempunyai lateks berwarna jingga seperti iodin. Lateks jingga daripada kulit batang membuktikan kewujudan sebatian xanthon. Pengekstrakan kulit batang menggunakan pelarut organik diikuti dengan pemisahan ekstensif menggunakan kaedah pemencilan yang biasa menghasilkan tiga sebatian xanthon yang telah dikenal pasti, prunifloron H (1), cochinchinon C (2) dan makluraxanthon (3). Menggunakan prosedur yang sama, antrakuinon, vismiakuinon (4) telah dipencilkan daripada akar pokok. Empat sebatian ini telah dikenal pasti menggunakan teknik RMN 1D dan 2D serta perbandingan dengan data literatur. Hasil kajian ini mencadangkan bahawa sebatian xanthon adalah sebatian utama *Cratoxylum.*

Kata kunci: cochinchinon C, guttiferae, makluraxanthon, prunifoloron H, vismiakuinon

Introduction

Cratoxylum is a genus in the Guttiferae family. The genus is in same family to mangosteen. In Thailand, some species of this genus have been used for food poisoning and internal bleeding [1]. *C. cochinchinense* has been used for fever, cough, diarrhea and ulcers in folk medicine [2]. While *C. formosum* has been used for diarrhea, internal bleeding and food poisoning [3]. Besides that, *Cratoxylum* plant usually used as timber. *Cratoxylum arborescens* is known as Geronggang in Malaysia [4]. Usually, the height of this plant is more than 20 m height and could achieved 1m in diameter without supporters. Local community at Gua musang reported the stem of this plant has yellow latex, and the latex is able to stop the bleeding from wound. This plant produce various types of secondary metabolites like xanthones [5] and triterpenoids [6,7]. The leaves of this plant was previously reported to contain a flavonoid, astilbin [8].

Materials and Methods

General Methods

Ultraviolet spectra were measured using UV Spectrophotometer (Shimadzu). Infrared spectra (IR) were recorded with a Perkin Elmer Infrared Spectrometer. ^{1}H and ^{13}C Nuclear Magnetic Resonance (NMR) spectra were obtained using FT-NMR Bruker 600 MHz, whereas high resolution mass spectra were obtained using Gas Chromatography Mass Spectra Shimadzu QP5050. Column chromatography (CC) was performed on silica gel (Merck). Pre-coated TLC sheets of silica gel 60F$_{254}$ were used small scale purification. Known compounds were identified by comparison of their spectroscopic data with those spectroscopic data reported in the literature.

Plant Material

The stem bark and roots of *Cratoxylum arborescens* were collected at Post Brooke, Gua Musang, Kelantan, Malaysia. The voucher specimen of *C. arborescens* (SK 1932/11) was deposited at Herbarium UPM Serdang, Selangor, Malaysia.

Extraction and Isolation

The stem bark (39.54 g) and roots (555.60 g) of *C. arborescens* were dried in oven at 50^{o}C, ground and extracted by using methanol as a solvent and the extraction was carried out at room temperature. The extraction of the stem bark powder was done for 24 hours by employing orbital shaker. The extraction was carried out for 3 times, whilst the roots powder was soaked in methanol for five days at room temperature.

The methanol extracts of the stem bark (11.14 g) and the roots (23.49 g) were fractionated with hexane and methanol (ratio 1:1). Fractionation of the stem bark extract yielded 2.73 g hexane fraction (GGCA) and 6.55 g methanol fraction (GGCC) while only 0.54 g fraction hexane of the roots extract (GGAA) and 13.52 g of methanol fraction (GGAC).

The chemical components in hexane fraction of stem bark were separated by using column chromatography technique (CC). The mixture of chloroform, ethyl acetate and methanol as mobile phase yielded 623 fractions of 5 mL eluent. Fractions 33-37 (30.8 mg) were combined and further purified by using preparative thin layer chromatography (PTLC) with chloroform as mobile phase and 5.8 mg yellowish crystal was obtained (GGCA 1). By employing PTLC on combined fractions 120-137 using the same mobile phase yielded GGCA 2, a yellowish amorphous (11.3 mg). Fractions 165-171 were combined and further purified by using PTLC with a mixture of chloroform: ethyl acetate (9:1) as solvent yielded GGCA 4 (5.8 mg) as a yellowish amorphous.

Initial purification of methanol fraction of roots by using vacuum liquid chromatography (VLC) with mobile phase of increasing polarity from 100% ethyl acetate until 100% methanol gave 14 fractions of 200 mL eluent. Fractions 1-3 were combined for further purification by using CC (internal diameter 1.0 cm x 50 cm height) with a mixture of ethyl acetate: methanol (4:1) as an eluting solvent. The purification gave 214 fractions (5 mL each fraction). Fractions 4-6 were combined for further purification using PTLC with hexane: ethyl acetate (9:1) as mobile phase. An orange crystal (6.4 mg) was obtained and named as GGAC 1. The structure of the purified compound was analyzed using NMR, GCMS, UV and IR spectrometer.

Pruniflorone H (1)

Yellow crystal. UV λ_{max} (MeOH) : 335.6 (0.168), 290.8 (0.301), 281.4 (0.302), 256.0 (0.213), 241.8 (0.210) and 204.4 (0.231) nm. IR ν_{max} (KBr) : 3365 (O-H), 2924, 2854, 1634, 1600 and 1576 cm^{-1}. NMR ^{1}H (CDCl$_3$, 600 MHz) : δ 5.07 (d, *J*=10.62 Hz, H-3a), 5.21 (d, *J*=17.64 Hz, H-3b), 6.99 (d, *J*=8.88 Hz, H-7), 7.77 (d, *J*=8.88 Hz, H-8), 6.83 (d, *J*=10.08 Hz, H-1'), 5.59 (d, *J*=10.08 Hz, H-2'), 1.88-1.95 (m, H-4'a), 1.72-1.76 (m, H-4'b), 2.10-2.21 (m, H-5'), 5.13 (br t, *J*=7.2 Hz, H-6'), 1.69 (s, H-8'), 1.47 (s, H-9'), 1.61 (s, H-10'), 6.69 (dd, *J*=10.56, 17.64 Hz, H-2"), 1.67 (s, H-4"), 1.67 (s, H-5"), 13.60 (s, 1-OH), 6.30 (s, 6-OH), 4.05 (s, 6-OCH$_3$). NMR ^{13}C (CDCl$_3$, 125 MHz) : δ 156.7

(C-1), 105.1 (C-2), 159.5 (C-3), 113.0 (C-4), 154.4 (C-4a), 144.3 (C-4b), 133.4 (C-5), 151.5 (C-6), 108.4 (C-7), 116.9 (C-8), 114.2 (C-8a), 181.0 (C-9), 102.9 (C-9a), 116.6 (C-1'), 125.7 (C-2'), 81.1 (C-3'), 41.8 (C-4'), 23.3 (C-5'), 123.7 (C-6'), 132.2 (C-7'), 17.7 (C-8'), 27.0 (C-9'), 25.8 (C-10'), 41.3 (C-1"), 155.4 (C-2"), 104.4 (C-3"), 28.3 (C-4"), 28.6 (C-5") and 56.6 (6-OCH_3).

Cochinchinone C (2)

Yellow crystal. UV λ_{max} (MeOH) : 338 (0.704) and 292 (1.608) nm. IR ν_{max} (KBr) : 2923, 1748, 1640.23, 1600, 1370, 1231 and 800 cm^{-1}. NMR ^{1}H ($CDCl_3$, 600 MHz) : δ 6.56 (dd, *J*=0.96, 0.24 Hz, H-2), 7.44 (dt, *J*=8.22, 1.68 Hz, H-3), 6.56 (dd, *J*=0.96, 0.24 Hz, H-4), 7.54 (s, H-8), 2.40 (d, *J*=12.78 Hz, H-10a), 1.61 (d, *J*=1.56Hz, H-10b), 2.56 (d, *J*= 9.36 Hz, H-11), 1.71 (s, H-13), 1.37 (s, H-14), 2.67 (d, *J*=7.2Hz, H-15), 4.40 (br t, *J*=6.0 Hz, H-16), 1.37 (d, *J*=23.7Hz, H-18), 1.01 (s, H-19), 12.05 (d, *J*=1.74Hz, 1-OH), 3.67 (d, *J*=1.74Hz, 7-OCH_3). NMR ^{13}C ($CDCl_3$, 125 MHz) : δ 162.8 (C-1), 109.6 (C-2), 139.1 (C-3), 107.5 (C-4), 159.4 (C-4a), 88.6 (C-4b), 84.2 (C-5), 201.3 (C-6), 84.8 (C-7), 135.1 (C-8), 132.1 (C-8a), 180.7 (C-9), 106.1 (C-9a), 29.7 (C-10), 49.3 (C-11), 84.1 (C-12), 30.4 (C-13), 29.1 (C-14), 29.2 (C-15), 118.5 (C-16), 135.9 (C-17), 25.6 (C-18), 16.7 (C-19) and 54.2 (7-OCH_3).

Macluraxanthone (3)

Yellow crystal. UV λ_{max} (MeOH) : 337 (0.601) dan 286 (1.331) nm. IR ν_{max} (KBr) : 3442, 3244 (OH), 1578, 1185, 1108 and 881 cm^{-1}. NMR ^{1}H ($CDCl_3$, 600 MHz) : δ 13.57 (1-OH), 6.98 (d, *J*=9.0 Hz, H-7), 7.70 (d, *J*=9.0 Hz, H-8), 5.64 (d, *J*=9.6 Hz, H-1'), 6.79 (d, *J*=9.6 Hz, H-2'), 6.77 (dd, *J*=10.2, 17.7 Hz, H-2"), 5.25 (d, *J*=17.4 Hz, H-3a"), 5.08 (d, *J*=10.2 Hz, H-3b"), 1.67 (s, 6H, H-4", H-5") and 1.54 (s, 6H, H-4', H-5'). RMN ^{13}C ($(CD_3)_2CO$, 125 MHz) : δ 157.0 (C1), 105.6 (C-2), 159.0 (C-3), 112.8 (C-4), 154.1 (C-4a), 144.5 (C-4b), 131.1 (C-5), 149.0 (C-6), 112.8 (C-7), 117.5 (C-8), 113.7 (C-8a), 180.8 (C-9), 103.0 (C-9a), 116.1 (C-1'), 127.3 (C-2'), 78.3 (C-3'), 27.9 (C-4', C-5', CH_3), 41.4 (C-1"), 156.7 (C-2"), 103.3 (C-3") and 28.2 (C-4", C-5", CH_3).

Vismiaquinone (4)

Orange crystal. UV λ_{max} (MeOH) : 289.0 (0.127), 267.0 (0.116) and 222.6 nm. IR ν_{max} (KBr) : 3472 (OH), 2925, 1376 and 1227 cm^{-1}. NMR ^{1}H ($CDCl_3$, 600 MHz) : δ 12.97 (s, 1-OH), 12.12 (s, 8-OH),7.42 (s, H-4), 7.63 (s, H-5), 7.08 (s, H-7), 6.67 (dd, *J*=16.2, 1.2 Hz, H-1'), 6.93 (dd, *J*=16.2, 7.2 Hz, H-2'), 2.46 (s, H-3'), 1.14 (d, *J*=6.6Hz, H-4'), 1.14 (d, *J*=6.6Hz, H-5'), 2.53 (sextet, 6-CH_3) and 4.05 (s, 3-OCH_3). NMR ^{13}C ($CDCl_3$, 125 MHz) : δ 162.1 (C-1), 120.0 (C-2), 163.0 (C-3), 103.4 (C-4), 132.1 (C-4a), 121.2 (C-5), 148.5 (C-6), 124.5 (C-7), 162.5 (C-8), 113.8 (C-8a), 133.2 (C-8b), 182.0 (C-9), 110.6 (C-9a), 191.5 (C-10), 115.8 (C-1'), 146.8 (C-2'), 33.4 (C-3'), 22.5 (C-4'), 22.5 (C-5'), 22.2 (6-CH_3) and 56.3 (3-OCH_3).

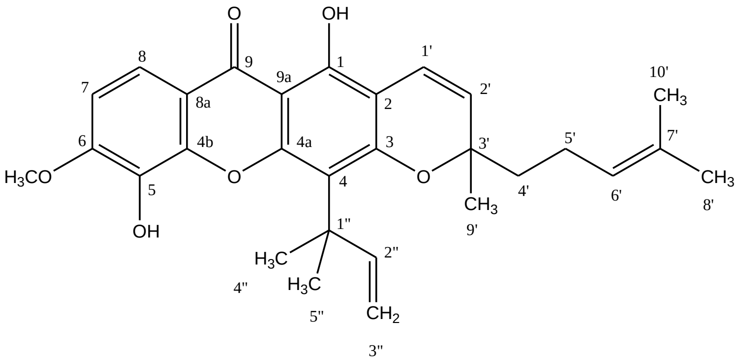
Results and Discussion

The structure of compounds were elucidated using spectroscopy methods i.e. IR, UV, MS and ^{1}H and ^{13}C NMR. The ^{1}H and ^{13}C NMR data of GGCA 1, GGCA 4 and GGAC 1 and GGCA 2 were presented in Table 1 and 2 respectively. Infrared spectrum of GGCA 1 showed OH (1-OH) absorption peak appeared at 3365 cm^{-1}. It is in agreement with NMR proton spectrum that showed one hydroxyl group at δ 13.60 (s) while another hydroxyl (5-OH) appeared at δ 6.30 (s). It also showed five singlet peaks of five methyl groups at δ 1.47, 1.61, 1.67 (2 CH_3) and 1.69 ppm. One methoxyl group could be observed at δ 4.05 ppm. Four olefinic protons were observed at δ 1.88-1.95 (m, H-4'a), .72-1.76 (m, H-4'b) and 2.10-2.20 (m, H-5'). Whilst other aromatic protons peaks appeared between δ 5.13 and 7.77 ppm. The ^{13}C NMR spectrum showed 14 quarternery carbons, five CH, three CH_2, one OCH_3 and five CH_3. The quarternery carbons were observed at δ 156.6 (C-1), 105.0 (C-2), 159.4 (C-3), 112.9 (C-4), 154.4 (C-4a), 144.3 (C-4b), 133.4 (C-5), 151.4 (C-6), 114.1 (C-8a), 180.9 (C-9), 102.9 (C-9a), 81.0 (C-3'), 132.1 (C-7') and 41.3 (C-1"). The CH carbons were observed at δ 108.3 (C-7), 116.8 (C-8), 116.6 (C-1'), 125.6 (C-2') and (C-6'). The CH_2 carbons were observed at δ 41.7 (C-4'), 23.2 (C-5) and 104.3 (C-3"), CH_3 carbon were observed at δ 17.7 (C-8'), 26.9 (C-9'), 25.7 (C-10'), 28.2 (C-4"), 28.5 (C-5") and the OCH_3 carbon was observed at δ 56.6. The proton and carbon NMR data of GGCA 1 were in agreement with pruniflorone H that has been isolated from *Cratoxylum formosum* ssp. *pruniflorum* reported by Boonnak et al. [9].

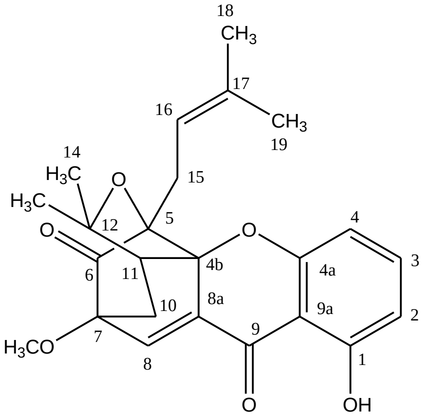
The ^{1}H NMR spectrum of GGCA 2 showed three singlet of three methyl groups at δ 1.03, 1.58 and 1.70 ppm, one methoxyl group at δ 3.66 (s) and a hydroxyl group that is forming a hydrogen bonding to carbonyl at δ 12.02 (s). Three aromatic protons that are an ABM system were observed at δ 6.56 (dq, *J*=0.96, 0.24 Hz, H-2), 7.44 (dt, *J*=8.22, 1.68 Hz, H-3) and 6.56 (dq, *J*=0.96, 0.24 Hz, H-4). A coupling of a methylene group (H-10a and H-10b) was observed at δ 2.40 (d, *J*=12.78Hz) and 1.61 (d, *J*=1.56Hz) respectively, a methine proton of H-11 at δ 2.56 (d, *J*=9.36Hz) and prenyl unit at δ 2.67 (d, *J*=7.2Hz, H-15), 4.40 (br t, *J*=6.0Hz, H-16), 1.37 (d, *J*=23.7Hz, H-18) and 1.01 (s, H-19). This GGCA 2 showed 24 peaks of carbon in NMR 150 MHz. A conjugated and non conjugated carbonyl resonances were observed at δ 180.7 (C-9) and 201.3 (C-6). Four methyl groups were observed in NMR proton at δ 30.4 (C-13), 29.1 (C-14), 25.6 (C-18) and 16.7 (C-19). Two CH_2 groups were observed at δ 29.7 (C-10) and 29.2 ppm (C-15). There are six peaks of CH which were observed at δ 109.6 (C-2), 139.1 (C-3), 107.5 (C-4), 135.1 (C-8), 49.3 (C-11) and 118.5 (C-16). While peaks of nine quarternery carbons were observed at δ 162.8 (C-1), 159.4 (C-4a), 88.6 (C-4b), 84.2 (C-5), 84.8 (C-7), 132.1 (C-8a), 106.1 (C-9a), 84.1 (C-12) and 135.9 (C-17). The spectral data of GGCA 2 were consistent with the spectral data of cochinchinone C that has been isolated from the roots of *C. cochinchinensis* [10].

The ^1H NMR spectrum of compound GGCA 4 showed an ortho correlation between H-7 and H-8 with *J* value of 9.0Hz. Same correlation was observed between H-1' and H-2' with *J*=9.6 Hz. A doublet doublet indicated a correlation between H-2" and H-3a" (*J*=17.4 Hz) and between H-2" and H-3b" (*J*=10.2Hz). The correlation between two protons that are attached to the same carbon (C-3) was observed at δ 5.25 (d, *J*=17.4 Hz, H-3a) and 5.07 (d, *J*=10.2 Hz, H-3b). A singlet observed at δ 13.57 was assigned to 1-OH, a singlet at δ 1.54 was assigned for H-4' and H-5' and a singlet at δ 1.67 was assigned for H-4" and H-5". The ^{13}C NMR showed the present of four methyl groups, one CH_2 and 10 quarternery carbons. Two methyl groups of C-4' andC-5' were observed as a singlet at δ 27.94 and the two other methyl groups of C-4" and C-5" were also appeared as a singlet at δ 28.17. The CH_2 was observed at δ 103.3 (C-3"), CH at δ 112.8 (C-7), 117.5 (C-8), 116.1 (C-1'), 127.3 (C-2') and 156.7 (C-2") while the 10 quarternery carbons were observed at δ 1576.00 (C-1), 105.6 (C-2), 159.0 (C-3), 112.8 (C-4), 154.1 (C-4a), 144.5 (C-4b), 131.1 (C-5), 149.0 (C-6), 113.7 (C-8a), 180.8 (C-9) and 103.0 (C-9a). The NMR data of ^1H and ^{13}C were agreement with the data obtained from macluraxanthone, a compound that has been isolated by Laphookhieo et al., 2009 from the stem bark of *C. maingayi*. Macluraxanthone was reported to be very potent against cancer cell NCI-H187. This compound also exhibited a strong activity against *P. falciparum* (anti-malarial activity) [11, 12].

The ^1H NMR spectrum of compound GGAC 1 showed five singlet at δ 7.42 (s, H-4), 7.63 (s, H-5), 7.08 (s, H-7), 12.12 (s, 8-OH) and 4.05 (s, 3-OCH_3). These five singlet peaks are an indication of anthraquinone skeleton. Five other peaks were observed at δ 6.67 (dd, *J*=16.2, 1.2 Hz, H-1') and 6.93 (dd, *J*=16.2, 7.2 Hz, H-2'), a sextet at δ 2.53 (sextet, H-3') and a doublet at δ 1.14 (d, *J*=6.6Hz) which represent H-4' and H-5'. Eleven quarternery carbon peaks and five CH peaks were observed in DEPT-C spectrum in region between 100 and 150 ppm i.e. C-4, C-5, C-7 C-1' and C-2'.There is no CH_2 peak observed whilst the three methyl groups were observed at δ 22.5 (C-4', C-5') and 22.2 (C-6'). The ^1H and ^{13}C NMR data of GGAC 1 were compared with the data of vismiaquinone, a compound that has been isolated from roots of *C. formosum* [13]. The COSY NMR spectrum confirmed that the structure of GGAC 1 is vismiaquinone. It was based on the correlation between H-1' with H-2' and H-3' with H-4'. These correlation means that the four protons are adjacent to each other.



(1)



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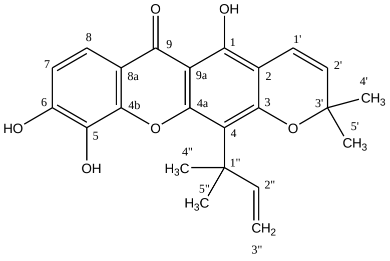

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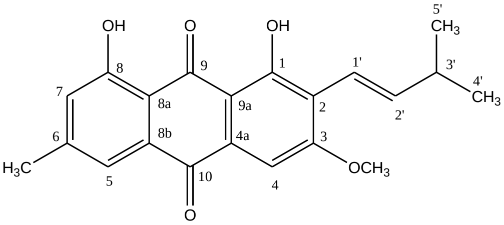

(4)

Table 1. The ^{1}H and ^{13}C NMR data of GGCA 1, GGCA 4 and GGAC 1

Position of C / H	Chemical shift, δ (ppm) C of GGCA 1	Chemical shift, δ (ppm) H of GGCA 1	Chemical shift, δ (ppm) C of GGCA 4	Chemical shift, δ (ppm) H of GGCA 4	Chemical shift, δ (ppm) C of GGAC 1	Chemical shift, δ (ppm) H of GGAC 1
1	156.6	13.60 (s, 1-OH)	157.0	13.57 (s, 1-OH)	162.1	12.97 (s, 1-OH)
2	105.0		105.6		120.0	
3a	159.4	5.07 (d, *J*=10.62 Hz)	159.0		163.0	
3b		5.21 (d, *J*=17.64 Hz)				
4	112.9		112.8		103.4	7.42 (s)
4a	154.4		154.1		132.1	
4b	144.3		144.5			
5	133.4	6.30 (s, 5-OH)	131.1		121.2	7.63 (s)
6	151.4		149.0		148.5	
7	108.3	6.99 (d, *J*=8.88 Hz)	112.8	6.98 (d, *J*=9.0 Hz)	124.5	7.08 (s)
8	116.8	7.77 (d, *J*=8.88 Hz)	117.5	7.70 (d, *J*=9.0 Hz)	162.5	
8a	114.1		113.7		113.8	12.12 (s, 8-OH)
8b					133.2	
9	180.9		180.8		182.0	
9a	102.9		103.0		110.6	
10a					191.5	
1’	116.6	6.83 (d, *J*=10.08 Hz)	116.1	5.64 (d, *J*=9.6 Hz)	115.8	6.67 (dd, *J*=16.2, 1.2 Hz)
2’	125.6	5.59 (d, *J*=10.08 Hz)	127.3	6.79 (d, *J*=9.6 Hz)	146.8	6.93 (dd, *J*=16.2, 7.2 Hz)
3’	81.0		78.3		33.4	2.53 (sextet)
4’a	41.7	1.88-1.95 (m)	27.9	1.54 (s)	22.5	1.14 (d, *J*=6.6 Hz)
4’b		1.72-1.76 (m)				
5’	23.2	2.10-2.20 (m)	27.9	1.54 (s)	22.5	1.14 (d, *J*=6.6 Hz)
6’	123.6	5.13 (br t, 7.2 Hz)				
7’	132.1					

Table 1 (cont'd). The ^{1}H and ^{13}C NMR data of GGCA 1, GGCA 4 and GGAC 1

Position of C / H	**Chemical shift, δ (ppm) C of GGCA 1**	**Chemical shift, δ (ppm) H of GGCA 1**	**Chemical shift, δ (ppm) C of GGCA 4**	**Chemical shift, δ (ppm) H of GGCA 4**	**Chemical shift, δ (ppm) C of GGAC 1**	**Chemical shift, δ (ppm) H of GGAC 1**
8'	17.7	1.69 (s)				
9'	26.9	1.47 (s)				
10'	25.7	1.61 (s)				
1"	41.3		41.4			
2"	155.3	6.69 (dd, *J*=17.6, 10.6Hz)	156.7	6.77 (dd, *J*=17.4, 10.2 Hz)		
3"a	104.3		103.3	5.25 (d, *J*=17.4 Hz)		
3"b				5.07 (d, *J*=10.2 Hz)		
4"	28.2	1.67 (s)	28.2	1.67 (s)		
5"	28.5	1.67 (s)	28.2	1.67 (s)		
6-CH_3					22.2	2.46 (s)
3-OCH_3					56.3	4.05 (s)
6-OCH_3	56.6	4.05 (s)				

Table 2. The ^{1}H and ^{13}C NMR data of GGCA 2

Position of C / H	**Chemical shift, δ (ppm) C of GGCA 2**	**Chemical shift, δ (ppm) H of GGCA 2**
1	162.80	12.05 (d, *J*=1.74 Hz, 1-OH)
2	109.55	6.56 (dq, *J*=0.96, 0.24Hz)
3a	139.07	7.44 (dt, *J*=8.22, 1.68 Hz)
4	107.48	6.56 (dq, *J*=0.96, 0.24Hz)
4a	159.41	
4b	88.64	
5	84.17	
6	201.30	
7	84.84	
8	135.09	7.54 (s)
8a	132.09	
9	180.73	
9a	106.06	
10a	29.68	2.40 (d, *J*=12.78Hz)
10b		1.61 (d, *J*=1.56Hz)
11	49.33	2.56 (d, *J*=9.36Hz)
12	84.05	
13	30.38	1.71 (s)
14	29.08	1.37 (s)
15	29.23	2.67 (d, *J*=7.2Hz)
16	118.48	4.40 (br t, *J*=6.0Hz)
17	135.86	
18	25.59	1.37 (d, *J*=23.7Hz)
19	16.68	1.01 (s)
7-OCH_3	54.16	3.67 (d, *J*=1.74Hz)

Conclusion

In the previous phytochemical studies on the leaves plant, one flavonoid, astilbin has been isolated and identified. Studies on the hexane fraction of stem bark of *C. arborescens,* gave pruniflorone H, cochinchinone C and macluraxanthone were isolated while an anthraquinone, vismiaquinone was isolated from the methanol fraction of the roots extract. This is the new finding of these four compounds on *C. arborescens* according to the author knowledge and reading.

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