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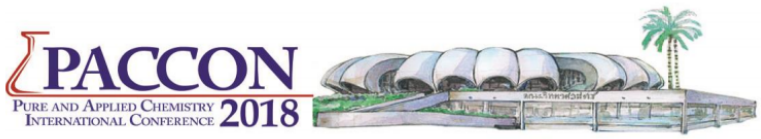

Chemical constituents from the leaves of *Artocapus chama* Buch.-Ham.

Suthida Rattanaburi[1]*, Wilawan Mahabusarakam[2,3]
[1]*Laboratory of Natural Products Chemistry, Faculty of Science and Technology, Phuket Rajabhat University, Muang, Phuket 83000, Thailand*
[2]*Department of Chemistry, Faculty of Science, Prince of Songkla University, Hat Yai, Songkhla 90110, Thailand*
[3]*Natural Product Research Center of Excellence, Prince of Songkla University, Hat Yai, Songkhla 90110, Thailand*
**E-mail: suthida.r@pkru.ac.th*

Abstract:
Phytochemical investigation of the leaf extract of *Artocarpus chama* Buch.-Ham. led to the isolation of four known phenolic compounds including three chalcones: xanthoangelol (**1**), 3-geranyl-2,3′,4,4′-tetrahydroxychalcone (**2**) and xanthoangelol B (**4**), and a flavonoid, apigenin (**3**). Their structures were characterized by spectroscopic methods and comparison with those of published compounds. All compounds were isolated from this plant for the first time.

1. Introduction

Artocarpus chama belonging to the family Moraceae is distributed in the Southern part of Thailand. Previous phytochemical investigations of plants in this genus have revealed the presence of prenylated flavonoids,[1] prenylated stilbenes[2,3] and chalcones.[4] Some of these compounds showed antioxidant[4,5] and cytotoxic[2,6] activities. In the present study, we report the isolation and structural elucidation of compounds **1**-**4** from the leaf extract of *A. chama*.

2. Materials and Methods

2.1 General

The IR spectra were measured with a FTS 165 FT-IR Perkin-Elmer spectrophotometer. UV spectra were recorded by a SPECORD S100 spectrophotometer. ^{1}H and ^{13}C-NMR spectra were recorded in acetone-d_6 using a FT-NMR Bruker Avance spectrometer (300 MHz for **1**, **2** and **4**; 500 MHz for **3**). Quick column chromatography (QCC) and column chromatography (CC) were carried out on silica gel 60H (Merck) and silica gel 60 (Merck), respectively. Precoated plates of silica gel 60 GF254 were used for TLC analysis.

2.2 Plant material

The leaves of *A. chama* were collected from Amphur Yan Ta Khao, Trang Province, Thailand in June, 2016. The herbarium specimen (S. Rattanaburi 04) was deposited at the herbarium of the Department of Biology, Faculty of Science, Prince of Songkla University, Thailand.

2.3 Extraction and isolation

The ground-dried leaves of *A. chama* (5 kg) were extracted with EtOH at room temperature for 3 days. After removal of EtOH, a green gum extract (380.2 g) was obtained which was partitioned with EtOAc and water. The EtOAc layer was evaporated to provide a dark green extract (118.4 g) which was separated by QCC using a gradient of hexane/acetone and acetone as eluent to obtain 12 fractions (A-L). Compounds **1** (1.4371 g), and **4** (3.8 mg) were obtained from fraction H after repeated purification by QCC (1:19 acetone/hexane). Fraction I was re-chromatographed by QCC (7:13 acetone/hexane) to give **3** (2.2 mg) and **2** (18.0 mg).

3. Results and Discussion

Chromatographic separation of EtOAc fraction from the leaves of *A. chama* led to the isolation of compounds **1-4** (Figure 1).

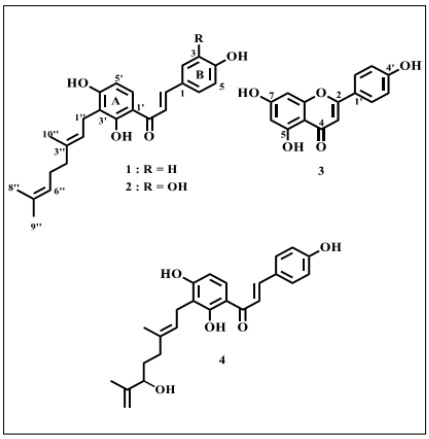

Figure 1. Structures of compounds **1**-**4**

Compound **1** was a yellow amorphous powder. Its UV spectrum showed maximum absorption bands at λ_{max} (MeOH) 225 and 368 nm whereas the IR spectrum showed the characteristic absorption bands of 3350 and 1625 cm^{-1} for O-H stretching and C=O stretching, respectively. The ^{13}C NMR spectrum showed the resonances of a carbonyl carbon (δ_C 192.2), three methyl carbons (δ_C 24.9, 15.8, 15.4), three methylene carbons (δ_C 39.6, 26.5, 21.3), ten methine carbons (δ_C 144.0, 130.1 × 2, 129.3, 124.3, 122.4, 118.2, 115.9 × 2, 107.2), three methylene carbons (δ_C 39.6, 26.5, 21.3) and seven quaternary carbons (δ_C 162.1, 160.3, 134.4, 130.8, 126.6, 115.3, 113.4). The ^1H NMR spectroscopic data of **1** (Table 1) indicated the presence of a chalcone derivative which was deduced from the following NMR spectroscopic data: a set of *trans* enone system at δ_H 7.82 (H-β) and 7.73 (H-α), one H-bonded hydroxy proton at δ_H14.00, two *ortho*-coupled aromatic protons at δ_H 7.95 (*d*, *J* = 8.7 Hz, H-6′) and 6.53 (*d*, *J* = 8.7 Hz, H-5′) of ring A, two doublet signals of a 1,4-disubstuted benzene ring at

Table 1. ^{13}C, ^1H NMR and HMBC spectroscopic data (300 MHz, acetone-d_6) for **1** and **2**

	1			**2**		
Position	δ_C	δ_H (*mult*, J_{Hz})	HMBC	δ_C	δ_H (*mult*, J_{Hz})	HMBC
1	126.6			127.2		
2	130.1	7.70 (*d*, 8.7)	4, β	114.9	7.32 (*d*, 3.0)	4, 6, β
3	115.9	6.91 (*d*, 8.7)	1, 4	145.6		
4	160.3			148.5		
5	115.9	6.91 (*d*, 8.7)	1, 4	115.5	6.88 (*d*, 9.0)	1, 3
6	130.1	7.70 (*d*, 8.7)	4, β	122.4	7.18 (*dd*, 9.0, 3.0)	2, 4, β
α	118.2	7.73 (*d*, 15.6)	1, 1′, C=O	117.5	7.65 (*d*, 15.0)	1, 1′, C=O
β	144.0	7.82 (*d*, 15.6)	1, 2, 6, C=O	144.5	7.74 (*d*, 15.0)	1, 2, 6, C=O
1′	113.4			113.4		
2′	164.3			164.3		
3′	115.3			115.2		
4′	162.1			162.1		
5′	107.2	6.53 (*d*, 8.7)	1′, 3′, 4′	107.2	6.54 (*d*, 9.0)	1′, 3′, 4′
6′	129.3	7.95 (*d*, 8.7)	2′, 4′, C=O	129.3	7.94 (*d*, 9.0)	2′, 4′
1″	21.3	3.36 (*d*, 7.2)	3′, 4′, 2″, 4″	21.3	3.36 (*d*, 6.0)	3′, 4′, 2″, 4″
2″	122.4	5.28 (*t*, 7.2)		122.4	5.28 (*t*, 6.0)	
3″	134.4			134.3		
4″	39.6	1.95 (*m*)		39.6	1.95 (*m*)	
5″	26.5	2.04 (*m*)		26.5	2.03 (*m*)	
6″	124.3	5.06 (*t*, 6.6)		124.3	5.06 (*t*, 6.6)	
7″	130.8			130.7		
8″	24.9	1.55 (*s*)	6″, 7″, 9″	16.8	1.53 (*s*)	6″, 7″, 9″
9″	15.8	1.53 (*s*)	6″, 7″, 8″	24.9	1.58 (*s*)	6″, 7″, 8″
10″	15.4	1.78 (*s*)	2″, 3″, 4″	15.4	1.78 (*s*)	2″, 3″, 4″
2′-OH		14.0 (*s*)	1′, 2′, 3′		14.0 (*s*)	1′, 2′, 3′
C=O	192.2			192.1		

δ_H 7.70 (*J* = 8.7 Hz, H-2, H-6) and 6.91 (*J* = 8.7 Hz, H-3, H-5) of ring B. The remaining signals were identified as a geranyl unit which showed resonances at δ_H 5.25 (*t*, *J* = 7.2 Hz, H-2″), 5.06 (*t*, *J* = 6.6 Hz, H-6″), 3.36 (*d*, *J* = 7.2 Hz, H-1″), 2.04 (*m*, H-5″), 1.95 (*m*, H-4″), 1.78 (*s*, H-10″), 1.55 (*s*, H-8″), 1.53 (*s*, H-9″). This group was placed at C-3′ due to HMBC correlations of H-1″ to C-3 ′, C-4′. Therefore, compound **1** was identified to be xanthoangelol.[7]

Compound **2** was a yellow amorphous powder. The ^{1}H and ^{13}C NMR spectroscopic data of **2** were similar to those of **1** (Table 1). The main differences were that signals for the 1,4-disubstuted benzene ring of **1** were replaced by those of a 1,2,4-trisubstuted benzene ring (δ_H 7.32, *d*, *J* = 3.0 Hz, H-2), 6.88 (*d*, *J* = 9.0 Hz, H-5), 7.18 (*dd*, *J* = 9.0 and 3.0 Hz, H-6). Therefore, compound **2** was assigned to 3-geranyl-2,3′,4,4′-tetrahydroxychalcone, previously isolated from the leaves of *Artocarpus incises*.[8]

Compound **4** was obtained as a yellow amorphous powder. The ^{1}H and ^{13}C NMR spectroscopic data of **4** were similar to those of **1** (Table 2). The major differences were that compound **4** showed a terminal alkene (δ_H 4.85 and 4.70, H-8″) and an oxymethine (δ_H 3.96, *J* = 6.0 Hz, H-6″) signals instead of the geranyl proton signals as observed in **1**. Compound **4** was thus identified as xanthoangelol B.[9]

Compound **3** was a yellow solid, m.p. 340-342 ºC. The UV spectrum suggested a flavonoid structure (λ_{max} (MeOH) 265 and 336 nm). The IR spectrum showed the characteristic absorption bands of O-H stretching (3350 cm^{-1}) and C=O stretching (1625 cm^{-1}). The ^{13}C NMR spectrum displayed 13 signals for 15 carbons of flavonoids core structure (Table 3). The ^{1}H NMR spectrum proved it to be a flavone with the olefinic signal at δ_H 6.51 (*s*, H-3), a chelated hydroxyl proton at δ_H 12.87 (5-OH) and 2 set of aromatic signals at δ_H 6.13 (*d*, *J* = 2.0 Hz, H-6), 6.41 (*d*, *J* = 2.0 Hz, H-8), 6.90 (*d*, *J* = 9.0 Hz, H-3′), 7.80 (*d*, *J* = 9.0 Hz, H-2′). Three hydroxyl groups were located at C-5, C-7, and C-4′ positions on the basis of HMBC correlations.

Table 2. ^{13}C, ^{1}H NMR and HMBC spectroscopic data (300 MHz, acetone-d_6) for **4**

Position	δ_C	δ_H (*mult*, J_{Hz})	HMBC
1	128.1		
2	132.1	7.73 (*d*, 9.0)	4, 6, *β*
3	177.2	6.92 (*d*, 9.0)	1, 4, 5
4	161.5		
5	117.2	6.92 (*d*, 9.0)	1, 3, 4
6	132.1	7.73 (*d*, 9.0)	2, 4, *β*
α	118.9	7.75 (*d*, 15.3)	1, 1′, C=O, *β*
β	145.4	7.84 (*d*, 15.3)	2, 6, C=O, *α*
1′	114.9		
2′	165.6		
3′	116.6		
4′	163.3		
5′	108.5	6.53 (*d*, 9.0)	1′, 3′, 4′
6′	130.7	7.98 (*d*, 9.0)	2′, 4′, C=O
1″	22.6	3.38 (*d*, 7.2)	2′, 3′, 4′, 2″, 3″
2″	123.6	5.31 (*t*, 7.2)	
3″	135.9		
4″	37.0	1.97 (*m*)	
5″	35.1	1.56 (*m*)	
6″	75.8	3.96 (*t*, 6.0)	4″, 7″, 8″, 9″
7″	149.8		
8″	110.7	4.85 (*brs*)	6″, 7″, 9″
		4.70 (*brs*)	
9″	18.3	1.66 (*s*)	6″, 7″, 8″
10″	16.8	1.80 (*s*)	2″, 3″, 4″
2′-OH		14.00 (*s*)	1′, 2′, 3′
C=O	193.5		

Table 3. ^{13}C, ^{1}H NMR and HMBC spectroscopic data (500 MHz, acetone-d_6) for compound **3**

Position	δ_C	δ_H (*mult*, J_{Hz})	HMBC
2	164.9		
3	103.8	6.51 (*s*)	1′, 2, 4, 4a
4	182.9		
4a	105.2		
5	163.1		
6	99.5	6.13 (*d*, 2.0)	4a, 5, 7, 8
7	164.9		
8	94.5	6.41 (*d*, 2.0)	4a, 6, 7
8a	158.6		
1′	123.1		
2′	128.9	7.80 (*d*, 9.0)	2, 4′, 6′
3′	116.6	6.90 (*d*, 9.0)	1′, 4′, 5′
4′	161.8		
5′	116.6	6.90 (*d*, 9.0)	1′, 3′, 4′,
6′	128.9	7.80 (*d*, 9.0)	2, 2′, 6′
5-OH		12.87 (*s*)	4a, 5, 6

The structure **3** was consistent to that of apigenin, previously isolated from the roots of *Astragalus propinquus*.[10]

4. Conclusion

Four known compounds (**1**-**4**) have been isolated from the EtOAc fraction of the leaves of *A. chama*. Their structures were established by spectroscopic data as well as comparison of these data with the literature.

Acknowledgements

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