Chemical constituents of *Euphorbia tirucalli* L.

Le Thi Kim Dung, Bui Xuan Hao, Nguyen Thi Anh Tuyet, Pham Nguyen Kim Tuyen, Duong Thuc Huy*

***Abstract*—*Euphorbia tirucalli* has not been chemically studied much in Vietnam. This research described the isolation and elucidation of compounds isolated from the plant collected in Binh Thuan. Multiple chromatographic methods were applied, including normal phase silica gel column chromatography and thin-layer chromatography. Seven compounds were isolated and their chemical structures were elucidated by spectroscopic analysis as well as comparing their data with the ones in the literature. They are arjunolic acid (1), eriodictyol (2), quercitrin (3), afzelin (4), scopoletin (5), 3,3′,4-trimethylellagic acid (6), and gallic acid (7). Among them, compound 1 a major component was isolated for the first time in Euphorbia genus, while three compounds 2, 4, and 5 were isolated from this species for the first time.**

Keywords*—arjunolic acid, phenolic compounds, flavonoid, *Euphorbia tirucalli

1. INTRODUCTION

Euphorbia tirucalli L. belongs to the Euphorbiaceae family and is a very popular herb in traditional herbal medicine [1]. There are approximately 1600 species in the *Euphorbia* genus. Some species of this genus have long been used as herbal drugs in China, India, Brazil and Southeast Asia. *Euphorbia tirucalli* L. is traditionally used in Vietnam. The extract and pure compounds from *Euphorbia tirucalli* were evaluated some biological activity, including antioxidant and antimicrobial [3], antifungal, antiviral [4], anti-inflammatory [5], cytotoxicity [6], and enzyme inhibitory activities [7].

Previous phytochemical investigation on the plant *Euphorbia tirucalli* reported the presence of phytosterols, tritepenes, diterpenes, polyphenols, tannins, …. [2, 8-10]. The latex from *Euphorbia tirucalli* showed the presence of ingenane- and tigliane-diterpenoids [2, 11, 12]. Up to 2017, no chemical studies on *Euphorbia tirucalli* were reported in Vietnam. Herein the isolation and structure elucidation of seven compounds (**1**–**7**) were presented (Fig. 1).

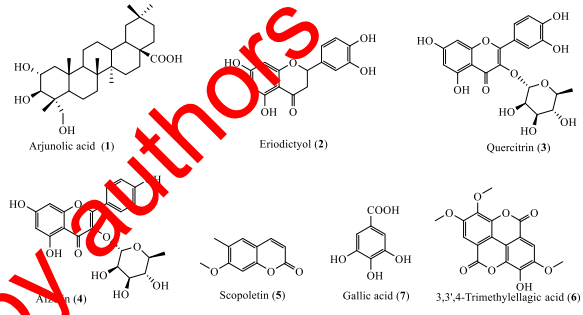

Fig.1. Chemical structures of 1–7

2. MATERIALS AND METHODS

General experimental procedures

NMR spectra were measured on Bruker Avance III (500 MHz for ^{1}H NMR and 125 MHz for ^{13}C NMR) spectrometer. Proton chemical shifts were referenced to the solvent residual signal of CD_3COCD_3 at δ_H 2.05. The ^{13}C NMR spectra were referenced to the central peak of CD_3COCD_3 at δ_C 29.4. HR–ESI–MS were recorded on a Bruker microTOF Q-II. TLC analyses were carried out on pre-coated silica gel 60 F_{254} or silica gel 60 RP–18 $F_{254}S$ (Merck) and spots were visualized by spraying with 10% H_2SO_4 solution followed by heating. Column chromatography (CC) was performed using silica gel 60 (0.040–0.063 mm, Himedia).

Plant material

The whole fresh plant of *Euphorbia tirucalli* (Euphorbiaceae) was collected from Hong Son village, Ham Thuan Bac, in Binh Thuan province in July 2014. The botanical sample was authenticated by Dr. Pham Van Ngot,

Received 29-05-2017; Accepted 12-10-2018; Published 20-11-2018

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Extraction and isolation

The dried sample was milled to obtain 3.5 kg of powder. The powder was extracted with EtOH (2 x 10 L) at 70 ^oC, to obtain the EtOH-soluble extract. While this solution was being evaporated, a precipitant (**P**, 250.4 g) occurred and was filtered off. The remaining solution was evaporated until dryness to obtain crude ethanolic extract (290.3 g).

The resultant ethanolic extract was sequentially partitioned with *n*-hexane, EtOAc, and *n*-BuOH to afford the extracts **H** (94.2 g), **EA** (61.8 g), and **Bu** (27.0 g), respectively. The **EA** extract was applied to a silica gel CC and eluted with a solvent system of *n*-hexane:EtOAc with the ratio 8:2, 5:5, and 0:10, to afford 3 fractions, **EA1** (10.32 g), **EA2** (2.5 g), and **EA3** (2.19 g), respectively. The fraction **EA2** was fractionated by CC with the solvent system *n*-hexane:EtOAc (1:4), to afford three fractions **EA2.1–3**. Fraction **EA2.1.3** (548.0 mg) was further applied to a silica gel CC eluted with *n*-hexane:EtOAc:EtOH:AcOH (5:1:0.2:0.1), to afford three sub-fractions **EA2.1.3.1-3**. Sub-fraction **EA2.1.3.1** (150.1 mg) was rechromatographed to obtain two compounds **5** (4.3 mg) and **7** (20 mg). Sub-fraction **EA2.1.3.2** (356 mg) was purified by preparative TLC using chloroform:MeOH:H_2O (4:0.38:0.02) to obtain three compounds **2** (6.5 mg), **3** (10.0 mg), and **4** (4.3 mg).

The precipitant **P** (250.4 g) was dissolved in hot solution of acetone:EtOH (1:1) then sequentially partitioned with *n*-hexane, EtOAc, and *n*-BuOH, to afford the extracts **PH** (100.4 g), **PA** (64.0 g), **PB** (21.0 g), respectively. The extract **PA** was applied to asilica gel CC, and eluted with a solvent system of *n*-hexane:EtOAc (8:2, 5:5, and 0:10), to afford 3 fractions, **PA1** (11.26 g), **PA2** (8.42 g), and **PA3** (17.14 g), respectively. A part of fraction **PA1** (1.0 g) was concentrated to dryness and washed three times by acetone, to obtain compound **6** (120.0 mg). A part of fraction **PA2** (150.0 mg) was carried out in the same manner as fraction **PA1** to obtain compound **2** (10.3 mg).

Arjunolic acid (**1**). White amorphous powder; the ^1H and ^{13}C NMR (acetone-d_6) spectroscopic data, see Table 1.

Eriodictyol (**2**). White amorphous powder; the ^1H and ^{13}C NMR (acetone-d_6) spectroscopic data, see Table 2.

Quercitrin (**3**). Light-yellow amorphous powder; the ^1H and ^{13}C NMR (acetone-d_6) spectroscopic data, see Table 2.

Afzelin (**4**). Light-yellow amorphous powder; the ^1H and ^{13}C NMR (acetone-d_6) spectroscopic data, see Table 2.

Scopoletin (**5**). Light-yellow amorphous powder; ^1H NMR (acetone-d_6), δ: 3.90 (6-OCH_3), 6.17 (d, J=9.5 Hz, H-3), 6.80 (*s*, H-8), 7.19 (*s*, H-5), 7.84 (*d*, J=9.5 Hz, H-4). ^{13}C NMR (acetone-d_6), δ: 160.4 (C-2), 112.4 (C-3), 143.7 (C-4), 109.1 (C-5), 144.9 (C-6), 154.1 (C-7), 102.8 (C-8), 150.9 (C-9), 111.2 (C-10), 55.7 (6-OCH_3).

3,3',4-Trimethylellagic acid (**6**). White amorphous powder; the ^1H and ^{13}C NMR (acetone-d_6) spectroscopic data was suitable to those in the literature [9].

Gallic acid (**7**). White amorphous powder; the ^1H and ^{13}C NMR (acetone-d_6) spectroscopic data was suitable to those in the literature [8].

3. RESULTS AND DISCUSSION

Three successive extractions were performed on the crude ethanol extract of the whole plant *Euphorbia tirucalli*. Further purification and isolation of compounds were carried out using silica gel chromatography, as described in the experimental section. Seven compounds were isolated and their structures were elucidated as arjunolic acid (**1**), eriodictyol (**2**), quercitrin (**3**), afzelin (**4**), scopoletin (**5**), 3,3',4-trimethylellagic acid (**6**), and gallic acid (**7**).

Compound **1** was obtained as a white amorphous powder. The ^1H NMR and HSQC spectra of **1** showed the presence of six quaternary methyls at δ_H 0.73 (3H, s), 0.80 (3H, s), 0.92 (3H, s), 0.94 (3H, s), 1.02 (3H, s), 1.17 (3H, s), two oxymethine protons at δ_H 3.39 (1H, d, J = 9.5 Hz) and 3.67 (1H, ddd, J = 11.5, 9.5, 4.5 Hz), one oxymethylene group at δ_H 3.28 (1H, d, J = 10.5 Hz) and 3.56 (1H, d, J = 10.5 Hz), and one olefinic proton at δ_H 5.25 (1H, dd, J = 7.0, 3.5 Hz). The ^{13}C NMR spectrum, in accordance with HSQC spectrum, confirmed the presence of thirty carbons comprising two olefinic carbons (δ_C 122.9 and 145.0), one hydroxycarbonyl carbon (δ_C 178.9), two

oxymethines (δ_C 68.9 and 78.5), one oxymethylene (δ_C 67.1), and six methyls (δ_C 13.8, 17.5, 17.7, 23.7, 26.4, 33.4). the comparison of the ^{13}C NMR data of **1** and those of oleanolic acid [14] indicated the same structures of B, C, D, and E rings of **1** and those of oleanolic acid, except for the ^{13}C NMR signals in the A-ring. This finding led to the identification of the position of the oxygenated methine and methylene groups in the A-ring. In HMBC spectrum, proton H-3 (δ_H 3.39, d, 9.5 Hz) showed cross-peaks to signals at δ_C 47.4 (C-1), 68.9 (C-2), 43.4 (C-4), 13.8 (C-24) and proton H-2 (δ_H 3.67, ddd, 11.5, 9.5, 4.5 Hz) correlated to C-1, C-4, and C-3 (δ_C 78.5), which indicated their vicinal positions (Fig. 2). Moreover, the coupling constant (J = 9.5 Hz) between protons H-3 and H-2 indicated their *axial* positions [24]. On the other hand, while axial proton H-3 was at the β orientation, found in many oleanane tritepenens [14], proton H-2 was defined at the α one. The oxymethylene protons at δ_H 3.28 (H-23a, d, J = 10.5 Hz), and 3.56 (H-23b, d, J = 10.5 Hz) showed HMBC correlations to C-3, C-4, and C-24, to determine their positions. The comparison of NMR data of **1** and those of arjunolic acid [15,16] showed that they were identical, accordingly, **1** was elucidated as arjunolic acid (Table 1). Arjunolic acid was found in *Terminalia arjuna* tree and other plants [17] and isolated as a major component from the apolar fraction **H2.4** of *Euphorbia tirucalli*.

Table 1. NMR spectral data of compounds **1** and arjunolic acid

	1[a]		Arjunolic acid[b]		1[a]		Arjunolic acid[b]
N	δ_C	δ_H, m J (Hz)	δ_C	N	δ_C	δ_H, m J (Hz)	δ_C
1	47.4		47.1	16	23.9		23.9
2	68.9	3.67 (ddd, 11.5, 9.5, 4.5)	68.9	17	46.9		47.0
3	78.5	3.39 (d, 9.5)	78.7	18	42.2		43.5
4	43.4		43.5	19	46.8		46.3
5	48.2		48.4	20	31.3		30.7
6	18.7		18.6	21	34.5		34.2
7	33.1		33.1	22	33.4		33.0
8	40.2		40.1	23	67.1	3.56 (d, 10.5) 3.28 (d, 10.5)	67.2
9	48.5		48.5	24	13.8	0.73 (s)	14.0
10	38.7		38.5	25	17.5	1.02 (s)	17.6
11	24.2		23.8	26	17.7	0.80 (s)	17.2
12	122.9	5.25 (dd, 7.0, 3.5)	122.5	27	26.4	1.17 (s)	26.1
13	145.0		144.1	28	178.9		178.6
14	42.6		42.4	29	33.4	0.92 (s)	32.9
15	28.4		28.3	30	23.7	0.94 (s)	23.7

[a] *recorded in acetone-d_6;* [b] *in pyridine-d_5*

	1[a]		Arjunolic acid[b]		1[a]		Arjunolic acid[b]
N	δ_C	δ_H, m J (Hz)	δ_C	N	δ_C	δ_H, m J (Hz)	δ_C
1	47.4		47.1	16	23.9		23.9
2	68.9	3.67 (ddd, 11.5, 9.5, 4.5)	68.9	17	46.9		47.0
3	78.5	3.39 (d, 9.5)	78.7	18	42.2		43.5
4	43.4		43.5	19	46.8		46.3
5	48.2		48.4	20	31.3		30.7
6	18.7		18.6	21	34.5		34.2
7	33.1		33.1	22	33.4		33.0
8	40.2		40.1	23	67.1	3.56 (d, 10.5) 3.28 (d, 10.5)	67.2
9	48.5		48.5	24	13.8	0.73 (s)	14.0
10	38.7		38.5	25	17.5	1.02 (s)	17.6
11	24.2		23.8	26	17.7	0.80 (s)	17.2
12	122.9	5.25 (dd, 7.0, 3.5)	122.5	27	26.4	1.17 (s)	26.1
13	145.0		144.1	28	178.9		178.6
14	42.6		42.4	29	33.4	0.92 (s)	32.9
15	28.4		28.3	30	23.7	0.94 (s)	23.7

[a] recorded in acetone-d_6; [b] in pyridine-d_5

Nevertheless, it has not yet been found in the *Euphorbia* genus. Arjunolic acid possessed various biological activities such as antidiabetic, antifungal, antibacterial, anticholinesterase, antitumor, antiasthmatic, wound healing and insect growth inhibitory activity and its potential use was taken into account as a novel promising therapeutic strategy [17, 18].

Compound **2** was obtained as a white amorphous powder. The ^{1}H NMR data of **2** showed the presence of two *meta* coupled aromatic protons at δ_H 5.96 and 5.94 (each 1H, d, J = 2.0 Hz), three aromatic protons of a 1, 2, 4 trisubstitutedbenzene moiety at δ_H 7.03 (1H, d, J = 1.5), 6.87 (1H, dd, J = 8.5, 1.5 Hz), and 6.86 (1H, d, J = 8.5 Hz), one methylene group at δ_H 3.14 (1H, dd, J = 17.0, 12.5, Hz) and 2.72 (1H, dd, J = 17.0, 3.0, Hz), one oxymethine moiety at δ_H 5.40 (1H, dd, J = 12.5, 3.0, Hz), and one chelated hydroxy group at δ_H 12.17 (Table 2). The ^{13}C NMR spectrum in accordance with HSQC spectrum showed fifteen carbons comprising five aromatic methine carbons, one oxymethine at δ_C 80.0, one methylene δ_C 43.6, one carbonyl δ_C 197.3 and seven aromatic quaternary carbons (including five oxygenated ones). These findings led to the identification of the flavanone skeleton of **2**. In the A-ring, proton H-6 (δ_H 5.94) and H-8 (δ_H 5.96) showed HMBC correlations to signals at δ_C 167.4 (C-7) and δ_C 103.2 (C-10), confirming their positions. In the B-ring, protons H-2' (δ_H 7.03), H-5' (δ_H 6.87), and H-6' (δ_H 6.86) showed HMBC cross-peaks to signals at δ_C 146.1 (C-3') and 146.5 (C-4'), determining the two oxygenated carbons C-3' and C-4' (Fig. 3). Moreover, the HMBC correlation betweem proton H-2 and signals at δ_C 197.3 (C-4), 131.6 (C-1'), 114.8 (C-2'), and 119.2 (C-6'), indicating the connectivity between the B- and C- rings at C-2. The comparison of NMR data of **2** and those of eriodictyol showed that they were identical, thus **2** was elucidated as eriodictyol [19]. Eriodictyol was isolated in *E. acanthothamnos* [20] and many plants but this is the first time found in *Euphorbia tirucalli*. This compound possessed antiinflamatory effect [21].

Compound **3** was obtained as a light-yellow amorphous powder. Analysis of 1D NMR data of **3** indicated that **3** was a flavonoid glycoside with the presence of L-rhamnopyranosyl moiety, comprising an amomeric proton signal at δ_H 5.19 (1H, d, J = 1.5 Hz, H–1"), four oxygenated proton signals in the ^{1}H zone of 3.1–4.0 ppm, and a characteristic methyl signal at δ_H 0.91 (3H, d, J = 6.0 Hz, H-6"). The NMR data of the aglycone moiety of **3** were similar with those of **2** (Table 2), except for the absence of the methine CH-2 and the methylene CH_2-3 groups in **2** and the presence of a new double bond between C-2 and C-3. This finding was confirmed by the HMBC correlation of H-2' and H-6' and C-2 (δ_C 158.4) (Fig. 3). The rhamnose moiety was linked to the aglycone moiety at its C-3, which was proved by the HMBC correlation of proton signal at δ_H 5.52 (H-1") and carbon C-3 (δ_C 135.9). All mentioned spectroscopic data well matched with those of quercitrin reported in literature [22]. Quercitrin was already reported from this species [10].

Compound **4** was obtained as a light-yellow amorphous powder. The comparison of 1D NMR data of **4** and **3** (both recorded in acetone-d_6) indicated that **4** was also a flavonoid glycoside with the presence of L-rhamnopyranosyl moiety, except for the absence of the hydroxy group in B-ring of the aglycone moiety (Table 2). This finding was confirmed by the presence of the 1,4-disubstituted benzene moiety in **4** instead of the 1,2,4 trisubtitued benzene in B-ring in **3**. The HMBC correlations between H-2'/6' and C-2 (δ_C 158.4), C-3' (δ_C 116.1), and C-4' (δ_C 161.0) supported this finding (Fig. 3). The comparison of NMR data of **4** and those of afzelin showed that they were identical, thus **4** was elucidated as afzelin [23]. Afzelin had been isolated in other *Euphorbia* plants such as *E. hirta* but this is the first time isolated in *Euphorbia tirucalli* [24].

Compound **5** was obtained as a light-yellow amorphous powder. Its ^{1}H NMR spectrum revealed the presence of seven resonances comprising two *cis* olefinic protons at δ_H 7.84 (1H, d, J = 9.5 Hz, H-4) and 6.17 (1H, d, J = 9.5 Hz, H-3), two *singlet* aromatic protons δ_H 6.80 (H-8) and 7.19 (H-5), one methoxy group at δ_H 3.90 (3H, s). The ^{13}C NMR of **5** showed ten carbon signals including one carbonyl ester group at δ_C 160.4 (C-2), four methine moieties at δ_C 143.7 (C-4), 112.4 (C-3), 109.1 (C-5), and 102.8 (C-8), one methoxy group at δ_C 55.7, and four aromatic quaternary carbons at δ_C 111.2 (C-10),

144.9 (C-6), 150.9 (C-9), and 154.1 (C-7) (three latter oxygenated). These NMR data of **5** were similar to those of scopoletin, accordingly, **5** was elucidated as scopoletin [25]. The HMBC correlations of **5** supported its structure as described in Fig. 2. Scopoletin was found in *E. hirta* or *E. heteradena* [26] but this is isolated from *Euphorbia tirucalli* for the first time.

Table 2. NMR spectral data of compounds **2-4**

Position	2			3			4		
	δ_C	δ_H, m	*J* (Hz)	δ_C	δ_H, m	*J* (Hz)	δ_C	δ_H, m	*J* (Hz)
2	80.0	5.40	dd, 12.5, 3.0	158.4			158.4		
3	43.6	3.14 2.72	dd, 17.0, 12.5 dd, 17.0, 12.5	135.9			135.6		
4	197.3			179.4			nd		
5	165.3			163.2			163.2		
6	96.8	5.94	d, 2.0	99.3	6.26	d, 2.0	98.8	6.26	d, 2.0
7	167.4			164.9			164.9		
8	95.9	5.96	d, 2.0	94.7	6.46	d, 2.0	93.5	6.46	d, 2.0
9	164.4			158.0			157.5		
10	103.2			105.7			105.5		
1'	131.6			122.9			121.0		
2'	114.8	7.03	d, 1.5	116.1	7.51	d, 2.0	128.5	7.86	d, 8.5
3'	146.1			149.0			116.1	7.01	d, 8.5
4'	146.5			145.8			161.0		
5'	116.1	6.86	d, 8.5	116.8	6.98	d, 8.0	116.8	7.01	d, 8.5
6'	119.2	6.87	dd, 8.5, 1.5	122.6	7.40	dd, 8.5, 2.0	128.5	7.86	d, 8.5
1"				102.8	5.52	br	102.8	5.54	d, 1.5
2"				71.3	4.23	m	71.2	4.21	dd, 3.0, 1.5
3"				71.5	3.71	dd, 9.0, 3.0	71.4	3.74	dd, 8.5, 3.0
4"				73.0	3.41	m	73.2	3.33	m
5"				72.0	3.33	m	72.2	3.30	m
6"				17.8	0.91	d, 6.0	17.9	0.90	d, 5.5
5-OH		12.17	s		12.72	s		12.71	S

nd: not determined

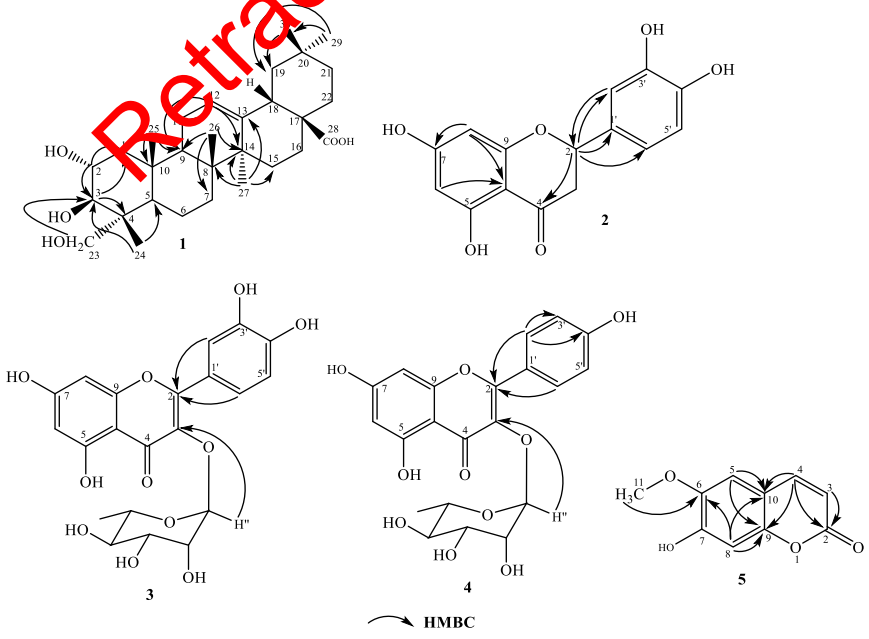

Fig. 2. Selected HMBC correlations of **1, 2, 3, 4** and **5**

4. CONCLUSION

From *Euphorbia tirucalli* collected in Binh Thuan province, seven compounds were isolated and elucidated, including arjunolic acid (**1**), eriodictyol (**2**), quercitrin (**3**), afzelin (**4**), scopoletin (**5**), 3,3′,4-trimethylellagic acid (**6**), and gallic acid (**7**). Among them, compound **1** was found for the first time in *Euphorbia* genus while three compounds **2**, **4**, and **5** were firstly isolated from this species. Furthermore, compounds **1** and **6** were confirmed as major components of this species.

REFERENCES

[1] N. Sharma, K.W. Samarakoon, R. Gyawali, Y.H. Park, S.J. Lee, S.J. Oh, T.H. Lee, D.K. Jeong, "Evaluation of the antioxidant, anti-inflammatory, and anticancer activities of *Euphorbia hirta* ethanolic extract", *Molecules*, vol. 19, pp. 14567–14581, 2014.

[2] J. Mwine, P.V. Damme, B.R. Hastilestari, J. Papenbrock, "*Euphorbia tirucalli L. (Euphorbiaceae)*, the miracle tree: current status of knowledge", ACS Symposium Series, 1127 (African Natural Plant Products Volume II), pp. 3–17, 2013.

[3] K.M. de Araujo, A. de Lima, J.doN. Silva, L.L. Rodrigues et al., "Identification of phenolic compounds and evaluation of antioxidant and antimicrobial properties of *Euphorbia tirucalli* L., *Antioxidants*, vol. 3, no. 1, pp. 159–175, 2014.

[4] C.K. Ramesh, M.N. Prabha, S.A. Deepak, K.N. Madhusudhan, "Screening of antiviral property against tobamoviruses in latex of *Euphorbia tirucalli* L", *Indian Journal of BioTechnology*, vol. 3, no. 1, pp. 1–3, 2009.

[5] S.S. Santana, M.L. Gennari Cardoso, F.C. Carvalho, M.C. Roque-Barreira, S. Santiago Ada, F.C. Alvim, C.P. Pirovani, "*Eutirucallin*, a RIP-2 type lectin from the latex of *Euphorbia tirucalli* L. presents proinflammatory properties", *Plos One*, vol. 9, no. 2, e88422, 2014.

[6] J.M.M. Dias, C.P. Chaves, "Combination of active fractions from the plants *Euphorbia tirucalli* L. and Ficus carica L. and method of treating cancer and AIDS", *PCT Int. Appl, WO* 2006007676 A1 20060126, 2006.

[7] B.A. Avelar, F.J.N. Lelis, R.S. Avelar, M. Weber, E.M. Souza Fagundes, M.T.P. Lopes, O.A. Martins Filho, G.E.A. Brito-Melo, "The crude latex of *Euphorbia tirucalli* modulates the cytokine response of leukocytes, especially CD4+T lymphocytes", *Revista Brasileira de Farmacognosia*, vol. 21, no. 4, pp. 662–667, 2011.

[8] H. Uchida, H. Yamashita, M. Kajikawa, K. Ohyama, O. N. Osamu, R. Sugiyama, K. T. Yamato, T. Muranaka, H. Fukuzawa, M. Takemura, K. Ohyama, "Cloning and characterization of a squalene synthase gene from a petroleum plant, *Euphorbia tirucalli* L.", *Planta*, vol. 229, no. 6, pp. 1243–1252, 2009.

[9] A. Chatterjee, M. Chakrabarty, A.K. Ghosh, "Trimethylellagic acid from *Euphorbia tirucalli* L.", *Indian J. Chem. B.*, vol. 15, pp. 564–565, 1977.

[10] S.J. Lin, C.H. Yeh, L.M. Yang, P.C. Liu, F.L. Hsu, "Phenolic Compounds from Formosan *Euphorbia tirucalli*", *Journal of the Chinese Chemical Society*, vol. 48, no. 1, pp. 105–108, 2001.

[11] T. Yoshida, K. Yokoyama, O. Namba, T. Okuda, "Tannins and related polyphenols of euphorbiaceous plants: VII. Tirucallins A, B and euphorbin F, monomeric and dimeric ellagitannins from *Euphorbia tirucalli* L.", *Chemical and Pharmaceutical Bulletin*, vol. 39, pp. 1137–1143, 1991.

[12] G. Fuerstenberger, E. Hecker, "New highly irritant euphorbia factors from latex of *Euphorbia tirucalli* L.", *Experientia*, vol. 33, no. 8, pp. 986–988, 1977.

[13] G. Fuerstenberger, E. Hecker, "On the active principles of the spurge family (Euphorbiaceae). XI. [1] The skin irritant and tumor promoting diterpene esters of *Euphorbia tirucalli* L. originating from South Africa, *Zeitschrift fuer Naturforschung, C: Journal of Biosciences*, vol. 40C, no. 9-10, pp. 631–646, 1985.

[14] M. Watanabe, Y. Kobayashi, J. Ogihara, J. Kato, K. Oishi, "HIV-1 reverse transcriptase-inhibitory compound in *Salvia officinalis*", *Food Science and Technology Research*, vol. 6, no. 3, p. 218, 2000.

[15] S.B. Mahato, A.P. Kundu, "^{13}C-NMR spectra of pentacyclic triterpenoids-a compilation and some salient features", *Phytochemistry*, vol. 37, no. 6, pp. 2717–2728, 1994.

[16] J. Kalola, M. Rajani, "Extraction and TLC desitometric determination of triterpenoid acids (Arjungenin, arjunolic acid) from *Terminalia arjuna* stem bark without interference of tannins", *Chromatographia*, vol. 63, 475e481, 2006.

[17] J. Ghosh, P.C. Sil, "Review Arjunolic acid: A new multifunctional therapeutic promise of alternative medicine", *Biochimie*, vol. 95, 1098e1109, 2013.

[18] N.M. Elsherbiny, M.M.H. Al-Gayyar, "Anti-tumor activity of arjunolic acid against Ehrlich ascites carcinoma cells in vivo and *in vitro* through blocking TGF-β type 1 receptor", *Biomedicine & Pharmacotherapy*, vol. 82, pp. 28–34, 2016.

[19] Y.H. Huang, W.M. Zeng, G.Y. Li, G.Q. Liu, D.D. Zhao, J. Wang, Y.L. Zhang, "Characterization of a new sesquiterpene and antifungal activities of chemical constituents from *Dryopteris fragrans* (L.) Schott", *Molecules*, vol. 19, no. 1, pp. 507–513, 2014.

[20] V. Myrianthopoulos, N. Fokialakis, P. Magiatis, N. Aligiannis, B. Tekwani, A.L. Skaltsounis, "Constituents of *Euphorbia acanthothamnos* and evaluation of their antileishmanial activity", *Planta Med*., vol. 74, PB164, 2008.

[21] J.K. Lee, "Anti-inflammatory effects of eriodictyol in lipopolysaccharidestimulated raw 264.7 murine macrophages", *Archives of Pharmacal Research*, vol. 34, no. 4, pp. 671–679, 2011.

[22] S. Bose, S. Maji, P. Chakraborty, "Quercitrin from *Ixora coccinea* leaves and its anti-oxidant activity", *Journal of Pharma. Sci. Tech*., vol. 2, no. 2, pp. 72–74, 2013.

[23] Z. Zhang, H.N. ElSohly, X.C. Li, S.I. Khan, S.E. Broedel, R.E. Raulli, R.L. Cihlar, C. Burandt, L.A. Walker, "Phenolic compounds from *Nymphaea odorata*, *J. Nat. Pro*d., vol. 66, no. 4, pp. 548–550, 2003.

[24] Y. Liu, N. Murakami, H. Ji, P. Abreu, S. Zhang, "Antimalarial flavonol glycosides from *Euphorbia hirta*", *Pharmaceutical Biology*, vol. 45, no. 4, pp. 278–281, 2007.

[25] W. Liu, J. Hua, J. Zhou, H. Zhang, H. Zhu, Y. Cheng, R. Gust, "Synthesis and in vitro antitumor activity of novel scopoletin derivatives", *Bioorganic & Medicinal Chemistry Letters*, vol. 22, pp. 5008–5012, 2012.

[26] S. Okuzs, A. Ulubelen, A. Barla, "Terpenoids and aromatic compounds from *Euphorbia heteradena*", *Turk J. Chem*., vol. 26, pp. 457–463, 2002.

Thành phần hóa học của cây cảnh giao (*Euphorbia tirucalli* L.)

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Ngày nhận bản thảo 29-05-2017; ngày chấp nhận đăng 12-10-2018; ngày đăng 20-11-2018

Tóm tắt*— Cây Cảnh giao *Euphorbia tirucalli* chưa được nghiên cứu nhiều ở Việt Nam. Nghiên cứu này mô tả sự phân lập và xác định cấu trúc hóa học của một số hợp chất từ cây Cảnh giao sinh trưởng ở Bình Thuận. Các phương pháp sắc ký cột silica gel pha thuận và sắc ký lớp mỏng đã được sử dụng. Bảy hợp chất được cô lập và cấu trúc của chúng được xác định bằng các phương pháp phổ nghiệm cũng như so sánh với tài liệu tham khảo. Chúng là arjunolic acid (1), eriodictyol (2), quercitrin (3), afzelin (4), scopoletin (5), 3,3′,4-trimethylellagic acid (6), và gallic acid (7) được cô lập. Trong số chúng, arjunolic acid được biết là thành phần chính trong cây thuộc chi *Euphorbia*. Các hợp chất 2, 4, 5 lần đầu tiên được cô lập từ loài *Euphorbia tirucalli.

Từ khóa*—arjunolic acid, các hợp chất phenolic, flavonoid, *Euphorbia tirucalli