ISSN 1859 - 4735

JOURNAL OF MEDICINAL MATERIALS

No. 3 - Vol. 30
6/2025

NATIONAL INSTITUTE OF MEDICINAL MATERIALS

3B QUANG TRUNG - HOAN KIEM - HANOI - VIETNAM
TEL: (+84-24) 38247058 FAX: (+84-24) 39348740
Email: tapchiduoclieu@nimm.org.vn; tapchiduoclieu@gmail.com

JOURNAL OF MEDICINAL MATERIALS (Print and Electronic Journals)

EDITORIAL BOARD (Term 2025-2030)

(Attached to Decision No. 666/QD-VDL dated April 24, 2025 signed by the Director of Vietnam National Institute of Medicinal Materials)

EDITOR-IN-CHIEF

Assoc. Prof. PhD. Do Thi Ha

I. Subcommittee of Pharmacognosy - Traditional Medicine

- **Assoc. Prof. Dr. Sci. Nguyen Minh Khoi - Head of Subcommittee**
- Assoc. Prof. PhD. Nguyen Thuong Dong - Member
- Prof. PhD. Nguyen Minh Duc - Member
- Prof. PhD. Tran Cong Luan - Member
- Prof. PhD. Won Keun Oh - Member
- Assoc. Prof. PhD. Tran Hung - Member
- Assoc. Prof. PhD. Nguyen Thi Bich Thu - Member
- Assoc. Prof. PhD. Phuong Thien Thuong - Member
- Assoc. Prof. PhD. Phan Minh Giang - Member
- Assoc. Prof. PhD. Le Nguyen Thanh - Member
- Assoc. Prof. PhD. Le Viet Dung - Member
- Assoc. Prof. PhD. Nguyen Quoc Huy - Member
- Assoc. Prof. PhD. Nguyen Thu Hang - Member
- PhD. Tran Minh Ngoc - Member
- PhD. Nguyen Van Tai - Member
- Assoc. Prof. PhD. Le Dinh Chi - Member
- PhD. Nguyen Tuan Hiep - Member.

II. Subcommittee of Pharmacology - Clinical Pharmacy

- **Assoc. Prof. PhD. Pham Thi Nguyet Hang - Head of Subcommittee**
- Assoc. Prof. Dr.Sci. Do Trung Dam - Member
- Assoc. Prof. PhD. Nguyen Thi Thu Huong - Member
- Assoc. PhD. William R. Folk - Member
- Assoc. Prof. PhD. Pham Thi Van Anh - Member
- Assoc. Prof. PhD. Nguyen Thuy Duong - Member
- Assoc. Prof. PhD. Le Van Minh - Member
- PhD. Tran Thi Hien - Member.

III. Subcommittee of Agriculture - Biology

- **PhD. Nguyen Van Khiem - Head of Subcommittee**
- PhD. Phan Thuy Hien - Member
- Assoc. Prof. PhD. Nguyen Van Tap - Member
- Assoc. Prof. PhD. Pham Thanh Huyen - Member
- Prof. PhD. Tran The Bach - Member.

IV. Subcommittee of Secretariat Administration

- **Assoc. Prof. PhD. Le Nguyen Thanh - Head of Subcommittee**
- PhD. Le Thi Xoan - Academic Secretary
- BSc. Nguyen Thi Minh Loc - Administrative Secretary.

CONTENTS VOL. 30(3), 2025
(Pages 145 - 224)

Page	SCIENTIFIC RESEARCH

Journal of Medicinal Materials, 2025, Vol. 30, No. 3 (pp. 147 - 151)

ALKALOID AND PHENOLIC COMPOUNDS FROM THE STEMS OF *GOUANIA JAVANICA* MIQ.

Le Thi Loan[1,*], Dang Minh Tu[1], Ha Van Oanh[2], Nguyen Van Tai[1]

[1]*National Institute of Medicinal Materials (NIMM), Hanoi, 11022, Vietnam;*

[2]*Hanoi University of Pharmacy, Vietnam*

*Corresponding author: vloandkh@gmail.com

Received March 25th, 2025 Accepted April 18th, 2025

Summary

Five compounds were isolated from the stems of *Gouania javanica* Miq. collected in Dongnai province, including nuciferine (**1**), nuciferine *N*-oxide (**2**), lysicamine (**3**), vanillic acid (**4**), and scopoletin (**5**). The structures of these compounds were established by MS and NMR (1D- and 2D-NMR) spectral methods and by comparison with the published data. This is the first time these compounds were isolated from *Gouania* genus.

Keywords: *Gouania javanica* Miq.; *Aporphine alkaloid; Coumarin; Phenolic acid.*

1. Introduction

The genus *Gouania*, belonging to the family Rhamnaceae, is mainly distributed in tropical and subtropical regions and comprises about 73 species. Some species are employed in traditional medicine. In Sierra Leone, *G. longipetala* leaves are given to pregnant women before and during labour for quick and easy delivery [1]. *G. longipetala* leaves and stem bark are used to treat coughs, burns and heal wounds [1]. In Thailand, the decoction of *G. leptostachya* leaves and stems is used to treat convulsions in women who have just given birth [2]. Phytochemical research results on some species such as *G. longipetala, G. ulmifolia*, *G. leptostachya*,... showed that they contain triterpenoids, flavonoids, and saponins [3],[4],[5],[6].

In Vietnam, 2 species, *G. javanica* and *G. leptostachya* are reported [7]. Both the leaves and stems of these two species are used to soak in wine as a massage medicine for injuries and bruises caused by falls and beatings [7]. While the species *G. leptostachya* has been shown by some studies to contain triterpenoid saponins and flavonoid compounds that have anti-inflammatory effects [8],[9], phytochemical studies on *G. javanica* are very limited. Qualitative results showed that *G. javanica* leaves contain alkaloids, flavonoids, glycosides, saponins, and triterpenoids [10]. Extracts from *G. javanica* leaves have been shown to inhibit the growth of microbial strains, such as *Candida albicans* and *Aspergillus niger* [10]. Methanol extracts of *G. javanica* leaves were toxic to RAW264.7 cells [11]. Therefore, phytochemical studies of *G. javanica* Miq. will contribute to the chemical data as well as the basis for research on the biological effects of this species. In this study, we report the first isolation and structure elucidation of three alkaloids and two phenolic compounds from the stems of *G. javanica* Miq.

2. Materials and Methods

2.1. Plant material

The stems of *Gouania javanica* Miq. (Rhamnaceace) were collected in Dongnai province in October 2023. The research sample (DK01) was taxonomically identified name by MSc. Nguyen Quynh Nga and MSc. Dang Minh Tu, Institute of Medicinal Materials. Voucher specimens (06.2023.HTV) were deposited in the Department of Phytochemistry and the Center of Medicinal Material Resources, National Institute of Medicinal Materials. Fresh samples were dried at 50ºC, ground, and stored in sealed plastic bags until use.

2.2. General experimental procedures

The NMR spectra were obtained on a Bruker AM600 FT-NMR spectrometer (Karlsruhe, Germany) using TMS as an internal standard. The electrospray ionization mass spectroscopy (ESI-MS) was obtained on an LC-MS/MS (Shimadzu, Japan) and the HR-ESI-MS was obtained on Mass Spectrometer - Thermo Scientific LTQ Orbitrap

XL (Thermo Fisher Scientific, USA). *Silica gel* (Merck, 40-63 µm particle size) and C-18 reversed-phase *silica gel* (Fuji Silysia Chemical Ltd., 30-35 µm) were used for column chromatography (CC). Thin-layer chromatography (TLC) was carried out with *silica gel* $60F_{254}$ and RP-$18F_{254S}$ plates. Spots were detected under 254 and 366 nm UV light or by spraying with 10% sulfuric acid in 96% ethanol (EtOH) and heating.

2.3. Extraction and isolation

The stems of *G. javanica* (10.0 kg) were powdered and hot-extracted with 70% EtOH (3 times, 3 hours each time, ratio of solvent to sample 7:1 (L/kg)) at 70°C. The combined extracts were filtered and evaporated under reduced pressure to yield a brown residue (1.234 kg), which was suspended in distilled water and successively partitioned with organic solvents, then concentrated to yield *n*-hexane- (20.8 g), dichloromethane- (89.5 g), ethyl acetate (EtOAc)- (53.3 g), *n*-butanol- (302 g), and water-soluble fractions (612 g).

The ethyl acetate (EA) fraction (50 g) was separated using *silica gel* CC and eluted with a gradient of dichloromethane - MeOH (50:1 - 0:100, v/v) to obtain 12 fractions (E1-E12). Faction E9 (3 g) was separated on a reversed-phase C_{18} CC and eluted with 40% MeOH - 100% MeOH to give compounds **1** (13 mg), **2** (11 mg), and **3** (9 mg). Fraction E11 (10 g) was subjected to *silica gel* CC using EtOAc - MeOH (50:1 - 1:1, v/v) to obtain 8 subfractions (E11.1-E11.8). The subfraction E11.7 (0.8 g) was subjected to *silica gel* CC and eluted with dichloromethane - MeOH (10:1 - 1:1, v/v) to give compound **4** (10 mg).

The dichloromethane fraction (80 g) was separated using *silica gel* CC and eluted with a gradient of dichloromethane - MeOH (100:0 - 1:2, v/v) to obtain 16 fractions (D1-D16). The D5 fraction (2.05 g) was chromatographed over *silica gel* CC and eluted with dichloromethane - acetone (50:1 - 1:1, v/v) to obtain 10 subfractions (D5.1-D5.10). Compound **5** (11 mg) was purified from the D5.4 subfraction (152 mg) by crystallization in *n*-hexane.

Compound 1: Pale yellow crystals; HR-ESI-MS: *m/z* = 296.16489 $[M+H]^+$, ^{1}H- and ^{13}C-NMR: see Table 1.

Compound 2: Pale yellow powder; HR-ESI-MS: *m/z* = 312.15964 $[M+H]^+$, ^{1}H- and ^{13}C-NMR: see Table 1.

Compound 3: Pale yellow powder; HR-ESI-MS: *m/z* = 292.09702 $[M+H]^+$, ^{1}H- and ^{13}C-NMR: see Table 1.

Compound 4: White powder; ESI-MS: *m/z* 167.05 $[M-H]^-$; ^{1}H-NMR (600 MHz, $CDCl_3$) δ_H: 7.59 (1H, dd, *J* = 8.4 Hz, 1.8 Hz, H-6), 7.56 (1H, d, *J* = 1.8 Hz, H-2), 6.85 (1H, d, *J* = 8.4 Hz, H-5), 3.91 (3H, s, OCH_3); ^{13}C-NMR (150 MHz, $CDCl_3$): 123.1 (C-1), 113.9 (C-2), 148.7 (C-3), 152.7 (C-4), 115.8 (C-5), 125.3 (C-6), 170.0 (C-7), 56.4 (OCH_3).

Compound 5: White powder; ESI-MS: *m/z* 191.10 $[M-H]^-$; ^{1}H-NMR (500 MHz, $CDCl_3$) δ_H: 7.59 (1H, d, *J* = 9.5 Hz, H-4), 6.91 (1H, s, H-5), 6.84 (1H, s, H-8), 6.27 (1H, d, *J* = 9.5 Hz, H-3), 3.93 (3H, s, 6-OCH_3); ^{13}C-NMR (125 MHz, $CDCl_3$): 161.3 (C-2), 113.5 (C-3), 143.3 (C-4), 107.5 (C-5), 144.0 (C-6), 149.7 (C-7), 103.2 (C-8), 150.2 (C-9), 111.5 (C-10), 56.5 (6-OCH_3).

3. Results and discussion

From the stems of *G. javanica*, five compounds (**1** - **5**) were isolated (Fig. 1).

Compound **1** was isolated as pale yellow crystals. The HR-ESI-MS spectrum of **1** gave a *pseudo*-molecular ion peak at *m/z* = 296.16489 $[M+H]^+$, corresponding to the molecular formula $C_{19}H_{21}NO_2$ (calcd. for $[C_{19}H_{22}NO_2]^+$, 296.16451). The ^{1}H- and ^{13}C-NMR spectral data are shown in Table 1. The ^{1}H-NMR spectrum of **1** exhibited signals of 5 aromatic protons at δ_H 8.36 (1H, d, *J* = 7.8 Hz, H-11), 7.21-7.31 (3H, m, H-8, H-9, H-10), 6.63 (1H, s, H-3), 2 methoxy groups at δ_H 3.88 (3H, s, 2-OCH_3), 3.66 (3H, s, 1-OCH_3) and 1 *N*-methyl group at δ_H 2.54 (3H, s) along with aliphatic protons in the range of δ_H 2.48 - 3.19. The ^{13}C-NMR spectrum, combined with the HSQC spectrum of **1**, revealed signals of 19 carbons, including 12 aromatic carbons at δ_C values of 111.4 - 152.0; 3 methylene carbons at δ_C 53.3 (C-5), 35.2 (C-7), and 29.3 (C-4); 1 methine carbon at δ_C 62.4 (C-6a); and 3 methyl groups, one of which was attached to nitrogen at δ_C 44.0 (*N*-CH_3) and two attached to oxygen at δ_C 60.2 (1-OCH_3) and 55.9 (2-OCH_3). The MS and 1D-NMR spectral data indicated that **1** was an alkaloid. The positions of the methyl groups were determined through

HMBC interactions between the methyl proton at δ_H 2.54 (*N*-CH_3) with C-5 (δ_C 53.3) and C-6a (δ_C 62.4), the methoxy protons at δ_H 3.66 (1-OCH_3) with C-1 (δ_C 145.2), and the methoxy protons at δ_H 3.88 (2-OCH_3) with C-2 (δ_C 152.0), along with interactions of H-3 (δ_H 6.63) with C-4 (δ_C 29.3), C-3a (δ_C 128.4), C-1b (δ_C 128.7), C-1, and C-2. Based on the above analysis and in comparison with the literature [12], it could be concluded that compound **1** was nuciferine.

Compound **2** was isolated as a pale yellow powder. The HR-ESI-MS spectrum gave a *pseudo*-molecular ion peak at *m/z* = 312.15964 $[M+H]^+$ corresponding to the molecular formula $C_{19}H_{21}NO_3$ (calcd. for $[C_{19}H_{22}NO_3]^+$, 312.15942). The ^{1}H- and ^{13}C-NMR spectral data of **2** are shown in Table 1. These data showed the similarity between compounds **2** and **1**, except for the significant changes in chemical shifts of *N*-CH_3 ($\Delta\delta_C$ = +11.9 ppm), C-5 ($\Delta\delta_C$ = +11.4 ppm), and C-6a ($\Delta\delta_C$ = +10.7 ppm). In addition, the HR-ESI-MS spectrum showed a difference of 16 a.m.u corresponding with the difference of an oxygen atom between the two compounds. This suggested that **2** was a *N*-oxide derivative of **1**. Based on the spectral analysis and comparison with those previously reported in the literature [13],[14], **2** was identified as nuciferin *N*-oxide.

Compound **3** was isolated as a pale yellow powder. The HR-ESI-MS spectrum gave a *pseudo*-molecular ion peak at *m/z* = 292.09702 $[M+H]^+$ corresponding to the molecular formula $C_{18}H_{13}NO_3$ (calcd. for $[C_{18}H_{14}NO_3]^+$, 292.09682). The ^{1}H- and ^{13}C-NMR spectral data are shown in Table 1. These data showed that **3** was also an aporphine alkaloid with structural similarity of the A and D rings to those of compounds **1** and **2**. The difference between **3** and the alkaloids **1** and **2** was found in the B and C rings. Specifically, the B ring exhibited two olefinic protons at δ_H 8.09 (1H, d, *J* = 5.4 Hz, H-4) and 8.80 (1H, d, *J* = 5.4 Hz, H-5). For the C ring, no methylene group signal was observed, but instead, a signal of a ketone group appeared at δ_C 182. Based on these data and in comparison with the literature [15], **3** was identified as lysicamine.

Table 1. NMR data of compounds **1**-**3**

No.	1		2		3	
	δ_H[a,b] (mult., *J* = Hz)	δ_C[a,c]	δ_H[d,b] (mult., *J* = Hz)	δ_C[d,c]	δ_H[d,b] (mult., *J* = Hz)	δ_C[d,c]
1	-	145.2	-	147.6	-	154.4
1a	-	126.9	-	128.3	-	120.0
1b	-	128.7	-	120.8	-	123.2
2	-	152.0	-	155.2	-	158.9
3	6.63 (1H, s)	111.4	6.95 (1H, s)	112.5	7.61 (1H, s)	108.4
3a	-	128.4	-	126.5	-	138.0
4	2.68 (1H, dd, 15.6, 3.6) 3.16 (1H, m)	29.3	3.10 (1H, m) 3.51 (1H, m)	24.9	8.09 (1H, d, 5.4)	125.9
5	2.50 (1H, m) 3.02 (1H, m)	53.3	4.14 (2H, m)	64.7	8.80 (1H, d, 5.4)	144.5
6a	3.00 (1H, m)	62.4	4.87 (1H, m)	73.1	-	145.1
7	2.61 (1H, t, 13.2) 3.08 (1H, dd, 13.2, 3.6)	35.2	3.22 (1H, m) 3.45 (1H, dd, 13.8, 4.2)	30.5	-	182.0
7a	-	136.5	-	133.7	-	132.5
8	7.21 - 7.31 (3H, m)	127.9	7.45 (1H, br d, 7.2)	129.5	8.50 (1H, dd, 7.8, 1.2)	129.4
9		127.3	7.33 (1H, m)	129.5	7.66 (1H, t, 7.8)	129.9
10		127.0	7.37 (1H, m)	129.0	7.86 (1H, t, 7.8)	135.9
11	8.36 (1H, d, 7.8)	128.4	8.34 (1H, dd, 7.8, 1.2)	129.6	9.28 (1H, d, 7.8)	130.0
11a	-	132.2	-	132.3	-	135.9
N-CH_3	2.54 (3H, s)	44.0	3.82 (3H, s)	55.9		
1-OCH_3	3.66 (3H, s)	60.2	3.70 (3H, s)	60.8	4.09 (3H, s)	60.1
2-OCH_3	3.88 (3H, s)	55.9	3.93 (3H, s)	56.5	4.16 (3H, s)	56.0

[a]: $CDCl_3$, [b] 600 MHz, [c] 150 MHz, [d] CD_3OD.

Compound **4** was isolated as a white powder. The ESI-MS spectrum of **4** showed a *pseudo*-molecular ion peak at *m/z* 167.05 $[M-H]^-$, which indicated the molecular formula $C_8H_8O_4$. The ^{1}H-NMR spectrum of **4** showed resonance signals of 3 aromatic protons at δ_H 7.56 (1H, d, J = 1.8 Hz, H-2), 6.85 (1H, d, J = 8.4 Hz, H-5), and 7.59 (1H, dd, J = 8.4 Hz, 1.8 Hz, H-6) corresponding to an ABX system, and a resonance signal of a methoxy group at δ_H 3.91 (3H, s). The ^{13}C-NMR spectrum of **4** showed 8 carbons, including 1 carboxyl group (δ_C 170.0), 2 oxygenated aromatic carbons (δ_C 148.7 and 152.7), 1 carbon-linked aromatic carbon (δ_C 123.1), 3 aromatic methine carbons (δ_C 113.9, 115.8, and 125.3), along with one methoxy carbon (δ_C 56.4). The position of the methoxy group was determined at C-3 based on the chemical shift comparison between **4** and vanillic acid and isovanillic acid [16]. From the above spectral data, **4** was identified as vanillic acid.

Compound **5** was also isolated as a white powder. The ESI-MS spectrum of **5** showed a *pseudo*-molecular ion peak at *m/z* 191.10 $[M-H]^-$ which indicated the molecular formula $C_{10}H_8O_4$. The ^{1}H-NMR spectrum of **5** showed two isolated aromatic protons at δ_H 6.84 (1H, s) and 6.91 (1H, s) and two doublets at δ_H 6.27 (1H, d, J = 9.5 Hz) and 7.59 (1H, d, J = 9.5 Hz) of a *cis*-double bond. Additionally, a signal for a methoxy group appeared at δ_H 3.93 (3H, s). The ^{13}C-NMR and DEPT spectra of **5** revealed 10 carbons: eight aromatic or double-bond carbons in the range of δ_C 103.2 to 150.2; one methoxy carbon (δ_C 56.5), and a lactone carbonyl group at δ_C 161.3. Based on these data, **5** was identified as scopoletin, which is in agreement with the literature [17].

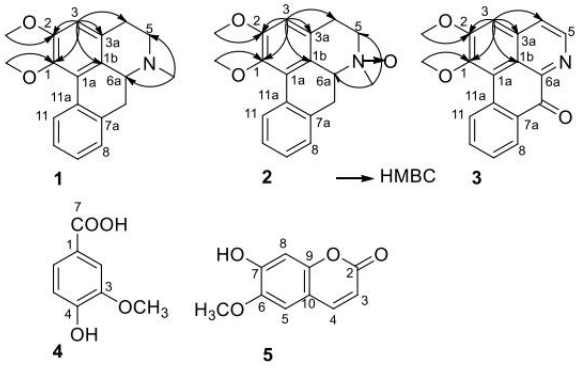

Fig. 1. Structures of isolated compounds from *G. javanica*

This is the first study on the chemical composition of *G. javanica* in Vietnam. As a result, five compounds were isolated from the stem of *G. javanica*, including three aporphine alkaloids (**1 - 3)** and two phenolic compounds (**4** and **5**). This is the first time they have been isolated from *Gouania* genus.

Nuciferine and its congeners are aporphine alkaloids found mainly in *Nelumbo nucifera* and *Nymphaea caerulea* species [18]. In addition, they are also found in some other species such as *Stephania tetrandra* and *Erythrina orientalis*…. [19]. In the Rhamnaceae family, nuciferine has been isolated from *Colubrina faralaotra* .... [20]. In particular, these compounds are believed to be among the active substances in the seeds of *Ziziphus jujuba* Mill. var. *spinosa* that contributes to the anxiolytic and anti-insomnia effects of this medicinal herb [21],[22],[23],[24]. In addition, many studies have demonstrated that nuciferin and its derivatives have anti-inflammatory effects, reduce insulin resistance in diabetes [25], lowering blood lipids, and reduce obesity [26],[27].

In the present study, three alkaloid compounds were isolated in minor quantities (9-13 mg), indicating that they may not be the major constituents. Notably, this is the first report of the isolation of this class of compounds from species of the genus *Gouania*, constituting a novel finding and contributing to the phytochemical knowledge of this genus.

In addition, one coumarin (scopoletin) and one phenolic acid (vanillic acid) were isolated from the stems of *G. javanica*. These compounds are relatively common in various plant species, however, this is the first report of their isolation from *Gouania* species.

4. Conclusion

In summary, from the stems of *G. javanica*, 5 compounds have been isolated: nuciferine (**1**), nuciferine *N*-oxide (**2**), lysicamine (**3**), vanillic acid (**4**), and scopoletin (**5**). All these compounds were isolated from *Gouania* genus for the first time.

Acknowledgments: *This work was supported by the National Institute of Medicinal Materials - Ministry of Health, project "Study on the chemical composition of the ariel parts of Gouania javanica".*

References

1. Koroma L., Kamarab L. M. (2020), Pharmacognostic investigation of dried powdered leaves of traditional medicinal plant *Gouania longipetala* used by pregnant women during labour for quick and easy delivery in Sierra Leone, *International Journal of Pharmaceutical Science and Health Care*, 6(10), 28-42.

2. Panyaphu K., Tran V. O., Sirisa-Ard P., Srisa-Nga P., ChansaKaow S., Nathakarnkitkul S. (2011), Medicinal plants of the Mien (Yao) in Northern Thailand and their potential value in the primary healthcare of postpartum women, *Journal of Ethnopharmacology*, 135(2), 226-237.

3. Nair S. P., Rao J. M. (1993), Gouanic acid from the leaves of *Gouania microcarpa*, *Phytochemistry*, 33(3), 711-712.

4. Hang N. T., Thu N. T. B., Vinh L. B., Phong N. V., Van O. T., Lee K. Y. (2023), A new ceanothane-type triterpenoid saponin isolated from *Gouania leptostachya* DC. var. *tonkinensis* Pit. and its underlying anti-inflammatory effects, *Journal of Microbiology and Biotechnology*, 33(7), 941-948.

5. Kennelly E. J., Lewis W. H., Winter R. E. K., Johnson S., Elvin-Lewis M., Gossling J. (1993), Triterpenoid saponins from *Gouania lupuloides*, *Journal of Natural Products*, 56(3), 402-410.

6. Gossan D. P. A., Magid A. A., Yao-Kouassi P. A., Coffy A. A., Harakat D., Voutquenne-Nazabadioko L. (2015), New acylated flavonol glycosides from the aerial parts of *Gouania longipetala*, *Phytochemistry Letters*, 11, 306-310.

7. Vo V. C. (1997), *Vietnamese Medicinal Plant Dictionary*. Medical Publishing House: Hanoi. 741.

8. Nguyen T. H. (2023), *Study on botanical characteristics, chemical constituents and in vitro anti-inflammatory activities of Gouania leptostachya* DC. *(*Rhamnaceae*)*, in *Medicinal Materials - Traditional Pharmacy*. National Institute of Medicinal Materials: Hanoi.

9. Nguyen V. A. (2010), *Study on botanical characteristics, chemical composition and antibacterial and antifungal effects of the plant Gouania leptostachya* DC. *(*Rhamnaceae*)*, in *Medicinal Materials - Traditional Pharmacy*. Hanoi University of Pharmacy: Hanoi.

10. Segismundo A. B., Florendo P. E., Pablico A. R. P. (2008), *In vitro* antifungal activity and phytochemical screening of *Gouania javanica* Miq. leaves", *The Vector: International Journal of Emerging Science, Technology and Management (IJESTM)*, 17(1), 1-10.

11. Nguyen H. D., Le T. H., Duong T. T. (2021), Screening for Vietnamese plant extracts with potential benefit for anti osteoclastogenesis, *Vietnam Journal of Science and Technology*, 59(4), 507-517.

12. Zhenjia Z., Minglin W., Daijie W., Wenjuan D., Xiao W., Chengchao Z. (2010), Preparative separation of alkaloids from *Nelumbo nucifera* leaves by conventional and pH-zone-refining counter-current chromatography, *Journal of Chromatography B*, 878(19), 1647-1651.

13. Yang Z., Song Z., Xue W., Sheng J., Shu Z., Shi Y., Liang J., Yao X. (2014), Synthesis and structure-activity relationship of nuciferine derivatives as potential acetylcholinesterase inhibitors, *Medicinal Chemistry Research*, 23(6), 3178-3186.

14. Makai S., Falk E., Morandi B. (2020), Direct synthesis of unprotected 2-azidoamines from alkenes via an iron-catalyzed difunctionalization reaction, *Journal of the American Chemical Society*, 142(51), 21548-21555.

15. Taha H. (2016), *Phytochemical and biological studies of the extracts of Pseuduvaria monticola and Pseuduvaria macrophylla*, in PhD Thesis. University of Malaya: Malaysia.

16. Do T., Hai N., Le T. H., Mai N. (2021), Chemical constituents and their alpha-glucosidase inhibitory activity from the stems of *Taxotrophis ilicifolius*, *Science and Technology Development Journal - Natural Sciences*, 5, 1334-1340.

17. Shah M., Shamim A., White L., Bertino M., Mesaik A., Soomro S. (2014), Anti-inflammatory properties of Au-scopoletin Nanoconjugates, *New Journal of Chemistry*, 38(11), 5566-5572.

18. Zhao T., Zhu Y., Zhao R., Xiong S., Sun J., Zhang J., Fan D., Deng J., Yang H. (2023), Structure-activity relationship, bioactivities, molecular mechanisms, and clinical application of nuciferine on inflammation-related diseases, *Pharmacological Research*, 193, 106820.

19. Wang R., Zhou J., Shi G., Liu Y., Yu D. (2020), Aporphine and phenanthrene alkaloids with antioxidant activity from the roots of *Stephania tetrandra*, *Fitoterapia*, 143, 104551.

20. Guinaudeau H., Cavé A., Paris R. (1971), The isolation of nuciferine from the bark of *Colubrina faralaotra*, *Natural Product Research*, 10(8), 1963-1966.

21. Gong L., Xie J. B., Luo Y., Qiu Z. D., Liu J. R., Mei N. J., Chen Z. Y., Wang F. L., Huang Y., Guo J. (2023), Research progress of quality control for the seed of *Ziziphus jujuba* var. *spinosa* (Bunge) Hu ex HF Chow (Suan-Zao-Ren) and its proprietary Chinese medicines, *Journal of Ethnopharmacology*, 307, 116204.

22. Wang H., Wu X., Wang J., Ding K. (2023), Comparative study of the bioactive constituents of raw and ripe *Zizyphi spinosi* Semen, *Natural Product Communications*, 18(7), 1934578X221119122.

23. Mahajan R., Chopda M. (2009), Phyto-Pharmacology of *Ziziphus jujuba* Mill-A plant review, *Pharmacognosy Reviews*, 3(6), 320-329.

24. Zhao X., Hou T., Zhou H., Liu Z., Liu Y., Wang C., Guo Z., Yu D., Xu Q., Wang J. (2023), Multi-effective components and their target mechanism of *Ziziphi spinosae* Semen in the treatment of insomnia, *Fitoterapia*, 171, 105712.

25. Amssayef A., Eddouks M. (2023), Alkaloids as promising agents for the management of insulin resistance: A review, *Current Pharmaceutical Design*, 29(39), 3123-3136.

26. Wan Y., Xia J., Xu J. F., Chen L., Yang Y., Wu J. J., Tang F., Ao H., Peng C. (2022), Nuciferine, an active ingredient derived from lotus leaf, lights up the way for the potential treatment of obesity and obesity-related diseases, *Pharmacological Research*, 175, 106002.

27. Huang X., Hao N., Chen G., Liu S., Che Z. (2022), Chemistry and biology of nuciferine, *Industrial Crops and Products*, 179, 114694.