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CONTENTS VOL.31(1+2), 2026 (SPECIAL ISSUE)  
(Pages 1 - 160)

| Page | SCIENTIFIC RESEARCH                                                                                                                                                                                                                                                                                                    |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3    | <b>Foreword: Special Issue Commemorating the 65<sup>th</sup> Anniversary of the National Institute of Medicinal Materials and Welcoming the 1<sup>st</sup> International Conference V.IMPACT-2026</b> - Assoc. Prof. Do Thi Ha, PhD                                                                                    |
|      | <b>REVIEW</b>                                                                                                                                                                                                                                                                                                          |
| 4    | <b>Results of Scientific Activities of the National Institute of Medicinal Materials (2016–2025) and Development Orientation Toward 2030</b> - Tran Minh Ngoc, Do Thi Ha, Pham Tuan Anh                                                                                                                                |
|      | <b>SCIENTIFIC RESEARCH</b>                                                                                                                                                                                                                                                                                             |
| 10   | <b>Triterpenoid Constituents from the Leaves of <i>Walsura pinnata</i> Hassk</b> - Bui Huu Tai, Nguyen Viet Dung, Nguyen Huy Hoang, Ngo Anh Bang, Duong Thi Dung, Duong Thi Hai Yen, Phan Thi Thanh Huong, Dan Thuy Hang, Pham Hai Yen, Phan Van Kiem, Nguyen Phuong Thao                                              |
| 17   | <b>Chemical Constituents from the Propolis of the Stingless Bee <i>Lepidotrigona terminata</i> (Smith, 1878) Collected in Gia Lai</b> - Diep Thi Lan Phuong, Nguyen Thu Thao Van, Vo Thi Thanh Tuyen, Nguyen Thi Nghia, Pham Ngoc Thach, Le Thi Cam Nhung, Le Duy Thanh, Vo Manh Tien, Tran Minh Ngoc, Le Nguyen Thanh |
| 23   | <b>Glycoside Constituents from <i>Abroma augustum</i> and their <i>in vitro</i> Antiproliferative Activity</b> - Ninh Thi Ngoc, Pham Thi Cham, Le Thi Vien, Tran Thi Hong Hanh, Do Thi Thao, Nguyen Xuan Cuong, Nguyen Hoai Nam                                                                                        |
| 29   | <b>Chemical Profiling and Anti-Inflammatory Effects of <i>Physalis angulata</i> in Lipopolysaccharide-Stimulated Bone Marrow–Derived Dendritic Cells</b> - Dinh Thi Huong, Le Ba Vinh, Nguyen Van Chinh, Nguyen Cao Cuong                                                                                              |
| 36   | <b>Phenolic Constituents from the Ethyl Ecetate Extract of <i>Camellia flava</i> Flowers (Theaceae) Collected in Phu Tho Province</b> - Do Thi Thuy, Nguyen Duong Hong Anh, Tran The Bach, Do Van Hieu, Do Duc Nhuan, Than Kieu My, Tran Minh Ngoc, Nguyen Thanh Cong, Le Nguyen Thanh                                 |
| 42   | <b>Lignans and Other Compounds from the Leaves of <i>Triadica rotundifolia</i> with Inhibitory Activity on Nitric Oxide Production</b> - Ninh Khac Ban, Tran My Linh, Ninh Khac Thanh Tung, Bui Van Thanh, Pham Hai Yen, Bui Huu Tai, Phan Van Kiem, Nguyen Phuong Thao                                                |
| 49   | <b>Chemical Constituents of <i>Ganoderma multipileum</i> Ding Hou, Ganodermataceae</b> - Nguyen Thi Duyen, Tran Thi Tuyet, Phan Quynh Trang, Nguyen Trung Hieu, Nguyen Duc Hieu, Nguyen Phuong Dai Nguyen                                                                                                              |
| 53   | <b>Chemical Composition, Antimicrobial and Cytotoxic Activities of the Leaf Essential Oil of <i>Knema globularia</i> (Lamk.) Warb. from Thanh Hoa, Vietnam</b> - Luong Le Uyen Trang, Pham Thi Huong Ly, Nguyen Thi Hoa Hien, Nguyen Thanh Huyen, Nguyen Thi Hien, Nguyen Thi Thu, Khong Thi Hoa                       |



|     |                                                                                                                                                                                                                                                                                                                                                                 |
|-----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 60  | <b>Azaphilone Derivatives Isolated from Endophytic Fungus <i>Penicillium sclerotiorum</i> - Ly Tu Loan, Vo Van Leo, Ma Chi Thanh</b>                                                                                                                                                                                                                            |
| 67  | <b>Chemical Constituents from the Aerial Parts of <i>Barleria lupulina</i> (Acanthaceae) - Ngo Thi Ngoc Yen, Do Hoang Anh, Nguyen Thi Thu, Nguyen Thi Ha Ly, Le Nguyen Thanh, Nguyen Quynh Nga, Dao Viet Quoc, Nguyen Thu Hang, Nguyen Hoang Minh, Nguyen Minh Khoi, Le Tran Nguyen Vu</b>                                                                      |
| 74  | <b>Determination of Essential Oil Content, Composition, and Total Polyphenol Content of <i>Rhizoma homalomenae occulta</i> Collected in Vietnam - Nguyen Thi Ha Ly, Pham Thi Hien, Ngo Thi Thanh Huong, Hoang Dieu Linh, Tran Huyen Trang, Nguyen Minh Khoi</b>                                                                                                 |
| 80  | <b>Establishment of an In-House Standard for <i>Prunellae spica</i> - Tran Huyen Trang, Pham Thi Hien, Nguyen Thi Ha Ly, Phan Van Truong, Vu Thi Diep, Nguyen Tra My, Nguyen Thi Hang, Nguyen Duong Hong Anh, Do Thi Ha</b>                                                                                                                                     |
| 88  | <b>HPTLC Scanner Method for the Simultaneous Determination of Lycopene and <math>\beta</math>-Carotene in Gac Seed Aril - Pham Thi Hien, Pham Thi Khuyen, Nguyen Thi Hang, Nguyen Thi Lan Hoa, Ta Thi Thao, Do Thi Ha, Nguyen Thi Ha Ly</b>                                                                                                                     |
| 96  | <b>Optimization of the Extraction Process from Yellow Camellia Flowers (<i>Camellia cucphuongensis</i> Ninh &amp; Rosmann) Collected in Phu Tho Province Using Response Surface Methodology - Nguyen Hoang Viet, Nguyen Dinh Quan, Do Duc Nhuan, Nguyen Duong Hong Anh, Tran Thi Mai Anh, Doan Van Nghia, Vu Xuan Hoa, Dang Mai Thien Ha, Nguyen Thanh Cong</b> |
| 105 | <b>Antioxidant, Antihyperglycemic, and Renal Protective Effects of <i>Hibiscus tiliaceus</i> L. Leaf Extract on Streptozotocin-Induced Hyperglycemia - Nguyen Thi Thu Huong, Nhieu Chinh Hoang, Nguyen Hoang Minh</b>                                                                                                                                           |
| 113 | <b>Acute Oral Toxicity and Laxative Effects of <i>Pharbitis nil</i> (L.) Choisy Seed Extract - Nguyen Thi Kim Oanh, Tran Vien Thong, Truong Huy Hieu, Ly Hai Trieu, Pham Thi Nguyet Hang, Nguyen Thi Vinh Hue, Do Thi Ha</b>                                                                                                                                    |
| 123 | <b>Evaluation of Memory-Enhancing Effects of <i>Morinda officinalis</i> How. Root Extracts in a Transgenic <i>hAPP Drosophila</i> Model of Alzheimer's Disease - Nguyen Van Hiep, Pham Thi Nguyet Hang, Trinh Dinh Luc, Leu Khanh Duy, Pham Anh Tung, Nguyen Thi Phuong, Nguyen Van Tai</b>                                                                     |
| 131 | <b>Anti-Inflammatory Effects of the Bark of <i>Phellodendron amurense</i> Rupr. in Experimental Models - Do Thi Hang, Le Thi Kim Van, Do Van Dung, Bui Thanh Tung</b>                                                                                                                                                                                           |
| 138 | <b>Neuroprotective Effects of Tianma Gouteng Decoction in a Middle Cerebral Artery Occlusion Model of Ischemic Stroke - Le Thi Xoan, Trinh Lan Phuong, Nguyen Van Hiep, Pham Thi Nguyet Hang, Nguyen Van Tai, Nguyen Thi Thu Trang, Nguyen Thi Thanh Loan, Nguyen Hung Son</b>                                                                                  |
| 147 | <b>Investigation of the Variation of Gymnemagenin Content in <i>Gymnema R.Br</i> Under the Influence of Certain Strains of Bacteria - Tong Thi Thanh Vuong, Tran Thi Minh Thuy, Le Thi Kim Van</b>                                                                                                                                                              |
| 154 | <b>Comparative Transcriptome Profiling of <i>Momordica cochinchinensis</i> (Lour.) Spreng. Aril Using Oxford Nanopore and Illumina Sequencing Technologies - Tran Duc Trung, Nguyen Hoang, Le Thi Tu Linh, Nguyen Thi Thu Hang, Pham Thanh Huyen, Truong Nhat My, Nguyen Thi Lan Hoa</b>                                                                        |

## CHEMICAL CONSTITUENTS OF *GANODERMA MULTIPILEUM* DING HOU, GANODERMATACEAE

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### Summary

Five compounds, lanosta-7,9(11),24-triene-3 $\beta$ ,26-diol (1), 3 $\beta$ -hydroxy-lanosta-7,9(11),24-trien (2), (22*E*)-ergosta-7,9,22-trien-3 $\beta$ -ol (3), (22*E*)-ergosta-7,22-dien-3-one (4), and methyl 2-hydroxynonacosanoate (5) were isolated from *Ganoderma multipileum* Ding Hou, Ganodermataceae, collected in Taynguyen. Their structures were elucidated by the spectroscopic methods, such as the ESI-MS and NMR (1D and 2D) spectroscopy and comparison with published data. Five compounds (1–5) are the first report of the chemical composition from *G. multipileum* in Vietnam.

**Keywords:** *Ganoderma multipileum*; Ganodermataceae; Lanostane; Ergostrol.

### 1. Introduction

*Ganoderma* consists of almost 300 species of the family Ganodermataceae globally, but about 26 species in Tay Nguyen [1]. Among them, *G. lucidum* has the most comprehensive research, but the number of publications on the species continues to increase annually. Because the species has many valuable activities as immunomodulatory [2], antitumor [3], anti-inflammation [4], cardio-vascular [5], liver protection, detoxification, hepatitis, and gastric ulcer [6],[7]. *G. multipileum* is quite popular in Kon Ka Kinh Park, Gialai [8]. *G. multipileum* parasitizes living plants of the *Delonix* genus in subtropical to tropical forests [9]. Morphologically, *G. multipileum* is quite similar to *G. lucidum*, leading to easy confusion between the two species. Research on the chemical composition and biological activity of this fungus is still very limited in Vietnam and worldwide. Only one study by Mei-Juan Li *et al.* [10] isolated 16 lanostane-triterpenoids from *G. multipileum* and their anti-inflammatory activity. In this report, we isolated and determined the structure of 5 compounds (Fig. 1): lanosta-7,9(11),24-triene-3 $\beta$ ,26-diol (1), 3 $\beta$ -hydroxy-lanosta-7,9(11),24-trien (2), (22*E*)-ergosta-7,9,22-trien-3 $\beta$ -ol (3), (22*E*)-ergosta-7,22-dien-3-one (4), and methyl 2-hydroxynonacosanoate (5). This is the first study on the chemical composition of this species in Vietnam.

### 2. Materials and methods

#### 2.1. Plant material

The fruiting bodies of the samples were collected in Kon Ka Kinh Park, Gialai, in

November 2024. The mushroom was identified as *Ganoderma multipileum* Ding Hou, belonging to the Ganodermataceae family by Assoc. Prof. Nguyen Phuong Dai Nguyen. A voucher specimen (GM112024) was deposited at the National Institute of Medicinal Materials.

#### 2.2. Methods

The NMR measurements were conducted using CDCl<sub>3</sub> as a solvent on a Bruker NMR spectrometer with a frequency of 600 MHz. Tetramethylsilane was used as an internal standard, and chemical shifts were reported in  $\delta$  (ppm). Electrospray Ionization Mass Spectrometry (ESI-MS) was performed using an Agilent 1100 series LC-MSD ion trap spectrometer. Column chromatography was performed using silica gel (70-230 or 230-400 mesh, Merck) and reversed-phase resin (YMC ODS-A 12 nm, S-75  $\mu$ m, Japan) as a stationary phase. Thin Layer Chromatography (TLC) was carried out on silica gel 60 F<sub>254</sub>S plates (Merck). Spots were detected by UV radiation (245 and 365 nm) or by spraying with 10% H<sub>2</sub>SO<sub>4</sub> followed by heating.

#### 2.3. Extraction and isolation

The dried and pulverized fruiting body of *G. multipileum* (7.0 kg) was extracted with 80% ethanol (v/v) for 3 hours at 70 °C, and concentrated under reduced pressure to yield total extract (TGM, 245 g, 3.5%). The total extract was suspended in water and successively extracted with dichloromethane (DCM) and ethyl acetate (EtOAc). The solvent was evaporated *in vacuo* to obtain the corresponding dichloromethane extract (DGM, 28.1 g), ethyl acetate extract (EGM, 13.4 g), and water extract (WGC, 197.6 g), respectively. TLC chromatograms of the fractions showed that the

EtOAc and DCM extracts were quite similar, so they were combined for column chromatography (DEGM, 42.4 g).

The DEGM extract (40 g) was chromatographed on a *silica gel* column, eluting with gradient solvents of DCM–MeOH (50:1–5:1–100% MeOH, v/v) to give 8 fractions (A–H). The A fraction (2.9 g) was continuously separated on a *silica gel* column, eluting with solvents of *n*-hexane–acetone (10:1, v/v) to afford 3 fractions (A1 – A3). Compound **4** (9 mg) was yielded from crystallizing and washing A.1 precipitation (107 mg) with an eluent of *n*-hexane–acetone (2:1, v/v). Compound **5** (6 mg) was yielded from the A3 fraction (156 mg) by reversed-phase column with an eluent of acetone–water (10:1, v/v). The C fraction (7.8 g) was separated three times on a *silica gel* column, eluting with solvents of DCM–MeOH (30:1–10:1, v/v) to yield the C.1.1.1 fraction. Compound **2** (5 mg) was yielded from the C.1.1.1 fraction (125 mg) by reversed-phase column with an eluent of MeOH–water (7:1, v/v). Compound **3** (7 mg) was yielded from preparative thin-layer chromatography, using the prepared solvents of DCM–MeOH (15:1, v/v) and eluting with DCM. The D fraction (1.7 g) was separated three times on a *silica gel* column, eluting with solvents of DCM–MeOH (15:1–5:1, v/v) to yield 4 fractions (D1 – D4). Compound **1** (12 mg) was yielded from the D2 fraction (125 mg) by reversed-phase column with an eluent of MeOH–water (5:1, v/v).

**Lanosta-7,9(11),24-triene-3 $\beta$ ,26-diol (1):** colorless needles; mp. 168–170°C; ESI-MS  $m/z$ : 441.5  $[M+H]^+$ ,  $C_{30}H_{48}O_2$ .  $^1H$ -NMR (600 MHz,  $CDCl_3$ )  $\delta_H$  (ppm) and  $^{13}C$ -NMR (150 MHz,  $CDCl_3$ ) see table 1.

**3 $\beta$ -Hydroxy-lanosta-7,9(11),24-triene (2):** white powder; ESI-MS  $m/z$ : 425.50  $[M+H]^+$ ,  $C_{30}H_{48}O$ .  $^1H$ -NMR (600 MHz,  $CDCl_3$ )  $\delta_H$  (ppm) and  $^{13}C$ -NMR (150 MHz,  $CDCl_3$ ) see Table 1.

**(22E)-Ergosta-7,9,22-trien-3 $\beta$ -ol (3):** white powder; ESI-MS  $m/z$ : 395.4  $[M-H]^-$ ,  $C_{28}H_{44}O$ .  $^1H$ -NMR (600 MHz,  $CDCl_3$ )  $\delta_H$  (ppm) and  $^{13}C$ -NMR (150 MHz,  $CDCl_3$ ) see table 1.

**(22E)-Ergosta-7,22-dien-3-one (4):** white powder; mp. 178–180°C; ESI-MS  $m/z$ : 419.0  $[M+Na]^+$ ,  $C_{28}H_{44}O$ .  $^1H$ -NMR (600 MHz,  $CDCl_3$ )  $\delta_H$  (ppm) and  $^{13}C$ -NMR (150 MHz,  $CDCl_3$ ) see Table 1.

**Methyl 2-hydroxynonacosanoate (5):** white powder; ESI-MS  $m/z$ : 467.5  $[M-H]^-$ ,  $C_{30}H_{60}O_3$ .  $^1H$ -NMR (600 MHz,  $CDCl_3$ )  $\delta_H$  (ppm): 4.19 (1H, dd,  $J = 4.0, 7.5$  Hz, H-2), 3.79 (3H, s,  $OCH_3$ ), 1.26 – 1.80 (52xH), 0.88 (3H, t,  $J = 14.0$  Hz, H-29).  $^{13}C$ -NMR (150 MHz,  $CDCl_3$ )  $\delta_C$  (ppm): 175.9 (COO), 70.5 (C-2), 52.5 ( $OCH_3$ ), 34.5 – 22.7 (26x $CH_2$ ), 14.1 (C-29).

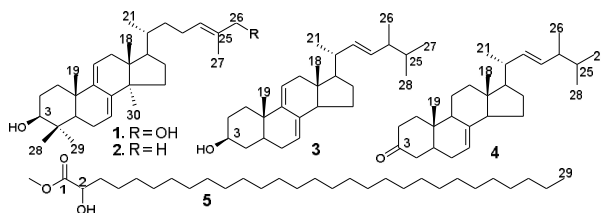


Fig. 1. Chemical structure of compounds **1** – **5**

### 3. Results and discussion

Compound **1** was obtained as colorless needles. Its molecular formula was determined to be  $C_{30}H_{48}O_2$  based on the ESI-MS spectrum with a peak at  $m/z$  441.5  $[M+H]^+$ . The  $^1H$ -NMR spectra of **1** showed the characteristic signals of a lanostane-triterpenoid. The  $^1H$ -NMR spectrum of **1** showed 7 methyl groups, including 6 *singlet* signals at  $\delta_H$  1.67 (3H, s, H-27), 1.09 (3H, s, H-29), 0.99 (3H, s, H-19), 0.88 (6H, s, H-28, H-30), 0.57 (3H, s, H-18) and 1 *doublet* signal at  $\delta_H$  0.92 (3H, d,  $J = 6.3$  Hz, H-21); three oxygen-linked proton signals at  $\delta_H$  4.0 (2H, s, H-26) and 3.25 (1H, dd,  $J = 2.4, 9.0$  Hz, H-3); 3 olefinic proton signals at  $\delta_H$  5.48 (1H, d,  $J = 6.0$  Hz, H-11), 5.40 (1H, t,  $J = 7.2$  Hz, H-24) and 5.32 (1H, d,  $J = 6.0$  Hz, H-7). The  $^{13}C$ -NMR spectrum exhibited 30 carbons: seven methyl carbon signals at  $\delta_C$  28.2 (C-29), 25.6 (C-30), 22.8 (C-19), 18.4 (C-21), 15.8 (C-28), 15.7 (C-18) and 13.6 (C-27); two oxygen-linked carbon signals at  $\delta_C$  79.0 (C-3) and 69.1 (C-26); and six olefinic carbon signals at  $\delta_C$  120.3 (C-7), 143.0 (C-8), 146.0 (C-9), 116.3 (C-11), 127.0 (C-24), and 134.0 (C-25). The HMBC correlations of H-28 ( $\delta_H$  0.88) and H-29 ( $\delta_H$  1.09) with C-3 ( $\delta_C$  79.0), C-4 ( $\delta_C$  38.7), and C-5 ( $\delta_C$  49.2) indicated that the hydroxy location was at C-3; the correlations of H-27 ( $\delta_H$  1.67) and H-24 ( $\delta_H$  4.0) with C-25 ( $\delta_C$  134.0) and C-26 ( $\delta_C$  69.1) indicated that the hydroxy location was at C-26, and one double bond is located at C-24/C-25. Furthermore, the other long-range correlations of H-7 ( $\delta_H$  5.32) with C-8 ( $\delta_C$  143.0) and C-6 ( $\delta_C$  23.0), and the correlations of H-11 ( $\delta_H$  5.48) with C-9 ( $\delta_C$  146.0) indicated that two double bonds are at C-7/C-8 and C-9/C-11. Based on these spectroscopic data and by comparison to published literature [11], compound **1** was identified as lanosta-7,9(11),24-triene-3 $\beta$ ,26-diol and named ganodermadiol. This compound was isolated from *G. multipileum* Mei-Juan Li *et al.* [10]

Compound **2** was obtained as a white powder. Its molecular formula was determined to be  $C_{30}H_{48}O$  based on the ESI-MS spectrum with a peak at  $m/z$  425.50  $[M+H]^+$ . The  $^1H$ -NMR and  $^{13}C$ -NMR spectra of compound **2** were similar to those of **1**, a lanostane-triterpenoid, except for a methyl signal at  $\delta_H$  1.69 (H-26). And the proton and carbon signals were identified in Fig. 1 and

corresponded completely to published spectral data [12], compound **2** was identified as 3 $\beta$ -hydroxy-lanosta-7,9(11),24-triene. Compound **2** was isolated for the first time from *G. multipileum*.

Compound **3** was obtained as a yellow amorphous powder. The ESI-MS spectrum with a peak at  $m/z$  395.4  $[M-H]^-$  suggested the molecular formula of **3** as  $C_{28}H_{44}O$ . The  $^1H$ -NMR spectrum of **3** showed the presence of 6 methyl groups at  $\delta_H$  1.04 (3H, d,  $J = 6.4$  Hz, H-21), 0.95 (3H, s, H-19), 0.92 (3H, d,  $J = 7.2$  Hz, H-28), 0.84 (3H, d,  $J = 7.2$  Hz, H-27), 0.83 (3H, d,  $J = 7.2$  Hz, H-26), and 0.63 (3H, s, H-18); one hydroxymethine group at  $\delta_H$  3.62 (1H, dd,  $J = 4.4$  & 10.6 Hz, H-3); 4 olefinic protons at  $\delta_H$  5.57 (1H, dd,  $J = 3.1, 5.4$  Hz, H-11), 5.39 (1H, dd,  $J = 3.1, 5.6$  Hz, H-7), 5.23 (1H, dd,  $J = 7.2$  & 15.0 Hz, H-22) and 5.18 (1H, dd,  $J = 7.2, 15.0$  Hz, H-23). The *E*-configuration of the double bond at C-22/C-23 was deduced from the coupling constants  $J = 15.0$  Hz of H-22 and H-23. The  $^{13}C$ -NMR spectrum displayed 28 carbon signals, including 6 methyl carbon signals at  $\delta_C$  21.1 (C-21), 20.0 (C-27), 19.7 (C-26), 17.6 (C-28), 16.3 (C-19) and 12.1 (C-18); one hydroxymethine carbon signal at  $\delta_C$  70.5; six olefinic carbon signals at  $\delta_C$  116.3 (C-7), 139.8 (C-8), 132.0 (C-22), 135.6 (C-23), 141.8 (C-9) and 119.6 (C-11). The HMBC correlations of H-7 ( $\delta_H$  5.39) with C-8 ( $\delta_C$  139.8) and C-5 ( $\delta_C$  46.3); and the correlations of H-11 ( $\delta_H$  5.57) with C-12 ( $\delta_C$  40.8), C-10 ( $\delta_C$  37.1), and C-9 ( $\delta_C$  141.8) indicated that two double bonds are at C-7/C-8 and C-9/C-11. Furthermore, the correlations of H-22 ( $\delta_H$  5.23) with C-20 ( $\delta_C$  40.4) and C-23 ( $\delta_C$  135.6); and the correlations of H-23 ( $\delta_H$  5.18) with C-22 ( $\delta_C$  132.0) and C-24 ( $\delta_C$  42.9) confirmed that one olefinic pair is C-22/C-23. Based on the above evidence and by comparison to published literature [13], compound **3** was identified as (22*E*)-ergosta-7,9,22-trien-3 $\beta$ -ol.

Compound **4** was isolated as a white amorphous powder with a melting point 178-180°C. Its molecular formula was determined as  $C_{28}H_{44}O$  by the ESI-MS at  $m/z$  419.0  $[M+Na]^+$ . The  $^1H$ - and  $^{13}C$ -NMR spectra of compound **4** were similar to

those of **3**, an ergostane-structure, except for a keton-carbon signal at  $\delta_C$  212.0 (C-3) and no olefinic signal at C-9/C-11. And the proton and carbon signals were identified in Table 1 and corresponded completely to published spectral data [14], compound **4** was identified as (22*E*)-ergosta-7,22-dien-3-one. Compound **4** was the first isolated from *G. multipileum*.

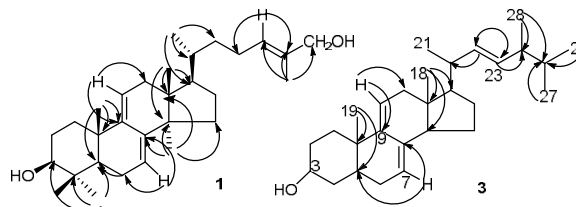


Fig. 2. The HMBC correlations of compounds **1** and **3**

Compound **5** was obtained as a white amorphous powder. The ESI-MS spectrum with a peak at  $m/z$  467.5  $[M-H]^-$  suggested the molecular formula of **5** as  $C_{30}H_{60}O_3$ . The  $^1H$ -NMR spectrum of **5** showed the presence of one *triplet* methyl group at  $\delta_H$  0.88 (3H, t,  $J = 14.0$  Hz, H-29); one *singlet* methoxy group at  $\delta_H$  3.79; 26 methylene groups at  $\delta_H$  to 1.26 from 1.80; and one hydroxymethine group at  $\delta_H$  4.19 (1H, dd,  $J = 4.0$  & 7.5 Hz, H-2). The carbon signals in the  $^{13}C$ -NMR and DEPT spectra displayed 30 carbon signals and corresponded completely to the proton signals in the  $^1H$ -NMR spectrum, including: one methyl signal at  $\delta_C$  14.1; one methoxy signal at  $\delta_C$  52.5; 26 methylene signals at  $\delta_C$  22.7 to 34.5; and one hydroxymethine signal at  $\delta_C$  70.5. Based on the 1D-NMR and MS spectral analysis, and comparison to published literature [15], compound **5** was identified as methyl 2-hydroxynonacosanoate.

The five compounds (**1–5**) were isolated for the first time from *G. multipileum* in Vietnam. Among them, four compounds (**1–4**) were isolated from *G. lucidum* [11-14], and two compounds (**2** and **5**) were published from *G. tropicum* [15]. Morphologically, the three species *G. lucidum*, *G. tropicum*, and *G. multipileum* are quite similar, so the isolated compounds can be used as chemical markers to distinguish these species.

Table 1.  $^1H$ - (600 MHz,  $CDCl_3$ ) and  $^{13}C$ -NMR (150 MHz,  $CDCl_3$ ) data of compounds **1–4**

| No. | 1                            |            |                   | 2                            |            |                   | 3                            |            |                   | 4                            |            |                   |
|-----|------------------------------|------------|-------------------|------------------------------|------------|-------------------|------------------------------|------------|-------------------|------------------------------|------------|-------------------|
|     | $\delta_H$ (mult., $J$ , Hz) | $\delta_C$ | $\delta_C^a$ [11] | $\delta_H$ (mult., $J$ , Hz) | $\delta_C$ | $\delta_C^b$ [12] | $\delta_H$ (mult., $J$ , Hz) | $\delta_C$ | $\delta_C^c$ [13] | $\delta_H$ (mult., $J$ , Hz) | $\delta_C$ | $\delta_C^d$ [14] |
| 1   |                              | 35.8       | 35.8              |                              | 35.8       | 35.7              |                              | 38.4       | 34.6              |                              | 38.8       | 38.8              |
| 2   |                              | 28.9       | 28.2              |                              | 27.9       | 27.8              |                              | 32.0       | 31.6              |                              | 38.1       | 38.1              |
| 3   | 3.25 (dd, 2.4, 10.9)         | 79.0       | 79.0              | 3.25 (dd, 4.6, 11.3)         | 79.0       | 79.0              | 3.62 (dd, 4.4, 10.6)         | 70.5       | 70.3              |                              | 212.0      | 211.9             |
| 4   |                              | 38.7       | 38.7              |                              | 38.7       | 38.7              |                              | 39.1       | 37.7              |                              | 44.2       | 44.3              |
| 5   |                              | 49.2       | 50.4              |                              | 49.2       | 49.1              |                              | 46.3       | 39.1              |                              | 42.8       | 42.8              |
| 6   |                              | 23.0       | 23.1              |                              | 23.0       | 23.0              |                              | 28.3       | 29.8              |                              | 30.0       | 30.1              |
| 7   | 5.32 (d, 6.0)                | 120.3      | 120.3             | 5.47 (br d, 6.2)             | 120.2      | 120.1             | 5.39 (dd, 3.1, 5.6)          | 116.3      | 118.0             | 5.18 (br s)                  | 117.0      | 117.0             |
| 8   |                              | 143.0      | 142.7             |                              | 142.8      | 142.7             |                              | 139.8      | 135.7             |                              | 139.5      | 139.5             |

| No. | 1                         |            |                   | 2                         |            |                   | 3                         |            |                   | 4                         |            |                   |
|-----|---------------------------|------------|-------------------|---------------------------|------------|-------------------|---------------------------|------------|-------------------|---------------------------|------------|-------------------|
|     | $\delta_H$ (mult., J, Hz) | $\delta_C$ | $\delta_C^a$ [11] | $\delta_H$ (mult., J, Hz) | $\delta_C$ | $\delta_C^b$ [12] | $\delta_H$ (mult., J, Hz) | $\delta_C$ | $\delta_C^c$ [13] | $\delta_H$ (mult., J, Hz) | $\delta_C$ | $\delta_C^c$ [14] |
| 9   |                           | 146.0      | 145.9             |                           | 146.0      | 145.9             |                           | 141.8      | 143.4             |                           | 48.8       | 48.9              |
| 10  |                           | 37.4       | 37.4              |                           | 37.4       | 37.3              |                           | 37.1       | 35.6              |                           | 34.4       | 34.4              |
| 11  | 5.48 (m, 6.0)             | 116.3      | 116.3             | 5.32 (br d, 6.0)          | 116.4      | 116.3             | 5.57 (dd, 3.1, 5.4)       | 119.6      | 118.8             |                           | 21.7       | 21.7              |
| 12  |                           | 37.9       | 37.9              |                           | 37.9       | 37.8              |                           | 40.3       | 42.1              |                           | 39.4       | 39.4              |
| 13  |                           | 43.7       | 43.8              |                           | 43.8       | 43.7              |                           | 42.9       | 42.7              |                           | 43.3       | 43.3              |
| 14  |                           | 50.7       | 49.2              |                           | 50.4       | 50.3              |                           | 54.6       | 51.5              |                           | 55.0       | 55.0              |
| 15  |                           | 27.9       | 28.0              |                           | 31.6       | 31.5              |                           | 23.0       | 23.1              |                           | 22.9       | 22.9              |
| 16  |                           | 31.5       | 31.5              |                           | 27.9       | 27.9              |                           | 28.3       | 28.8              |                           | 28.1       | 28.1              |
| 17  |                           | 51.0       | 50.9              |                           | 51.0       | 50.9              |                           | 55.8       | 56.0              |                           | 55.9       | 56.0              |
| 18  | 0.57 (s)                  | 15.7       | 15.7              | 0.57 (s)                  | 15.7       | 15.6              | 0.63 (s)                  | 12.1       | 11.4              | 0.56 (s)                  | 12.1       | 12.2              |
| 19  | 0.99 (s)                  | 22.8       | 22.8              | 0.99 (s)                  | 22.8       | 22.7              | 0.95 (s)                  | 16.3       | 19.3              | 1.02 (s)                  | 12.5       | 12.4              |
| 20  |                           | 36.1       | 36.1              |                           | 36.1       | 36.0              |                           | 40.4       | 40.3              |                           | 40.5       | 40.5              |
| 21  | 0.92 (d, 6.3)             | 18.4       | 18.4              | 0.91 (d, 6.4)             | 18.5       | 18.4              | 1.04 (d, 6.4)             | 21.1       | 19.6              | 1.03 (d, 6.4)             | 21.1       | 21.1              |
| 22  |                           | 36.0       | 36.0              |                           | 36.3       | 36.3              | 5.23 (dd, 7.2, 15.0)      | 132.0      | 131.5             | 5.19 (dd, 7.8, 15.2)      | 135.6      | 135.6             |
| 23  |                           | 24.6       | 24.6              |                           | 25.0       | 24.9              | 5.18 (dd, 7.2, 15.0)      | 135.6      | 135.0             | 5.22 (dd, 7.8, 15.2)      | 132.0      | 132.0             |
| 24  | 5.42 (t, 7.6)             | 127.0      | 127.0             | 5.11 (t, 6.4)             | 125.2      | 125.2             |                           | 42.9       | 42.7              |                           | 42.9       | 42.9              |
| 25  |                           | 134.0      | 134.3             |                           | 131.0      | 131.0             |                           | 33.1       | 32.9              |                           | 33.1       | 33.1              |
| 26  | 4.00 (s)                  | 69.1       | 69.1              | 1.69 (s)                  | 25.7       | 25.7              | 0.83 (d, 7.2)             | 19.7       | 19.8              | 0.92 (d, 7.8)             | 19.9       | 19.9              |
| 27  | 1.67 (s)                  | 13.6       | 13.7              | 1.61 (s)                  | 17.6       | 17.6              | 0.84 (d, 7.2)             | 20.0       | 20.6              | 0.83 (d, 7.2)             | 19.6       | 19.6              |
| 28  | 0.88 (s)                  | 15.8       | 15.8              | 0.88 (s)                  | 15.8       | 15.8              | 0.92 (d, 7.2)             | 17.6       | 17.6              | 0.84 (d, 7.2)             | 17.6       | 17.6              |
| 29  | 1.09 (s)                  | 28.2       | 27.8              | 1.01 (s)                  | 28.2       | 28.1              | -                         | -          | -                 | -                         | -          | -                 |
| 30  | 0.88 (s)                  | 25.6       | 25.6              | 0.88 (s)                  | 25.6       | 25.6              | -                         | -          | -                 | -                         | -          | -                 |

<sup>a</sup>: Measured in CDCl<sub>3</sub> and 125 MHz, <sup>b</sup>: Measured in CDCl<sub>3</sub> and 75.5 MHz, <sup>c</sup>: Measured in CDCl<sub>3</sub> and 25 MHz.

#### 4. Conclusion

Five compounds were obtained from the DCM and EtOAc extracts of *G. multipileum*, including lanosta-7,9(11),24-triene-3 $\beta$ ,26-diol (1), 3 $\beta$ -hydroxy-lanosta-7,9(11),24-trien (2), (22E)-ergosta-7,9,22-trien-3 $\beta$ -ol (3), (22E)-ergosta-7,22-dien-3-one (4), and methyl 2-hydroxynonacosanoate (5). The structures of

these compounds were established by spectral data and literature references.

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