Isolation and structural determination of compounds from *Alstonia scholaris* (L.) R. Br. (Apocynaceae), collected in Vietnam

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ABSTRACT

*Alstonia scholaris (L.) R. Br. belongs to the genus Alstonia in the family Apocynaceae. For the first time, the current research phytochemically studied on A. scholaris, collected from Vietnam. By silica gel column chromatographic separation, a triterpenoid betulin (**1**) and a sterol β-sitosterol (**3**) were found in the ethyl acetate (EtOAc) extract of the leaves. Meanwhile, isolation of the methanol (MeOH) extract of the bark yielded a triterpenoid β-amyrin (**2**), a sterol β-sitosterol (**3**) and a free sugar compound sucrose (**4**). Oxidation of compound **1** with $K_2Cr_2O_7$ in an acidic medium resulted in betunic acid derivative (**1a**) with a yield of 43.8%. The structures of these compounds were determined by analysis of spectroscopic data.*

Keywords: Apocynaceae; *Alstonia scholaris*; Triterpenoid; Sterol; Sugar.

1. INTRODUCTION

The genus *Alstonia* (family Apocynaceae) comprises approximately 40 to 60 species, including evergreen trees and shrubs. This genus is primarily distributed across Africa, Asia, the Americas, and Australia [1]. Species in the genus are widely utilized in traditional medicine. For instance, the barks of *A. constricta* and *A. scholaris* were used to treat malaria, toothache, rheumatism, and snake bites [2]. Additionally, the latex is employed to relieve sore throat, reduce fever, and alleviate cough. Many species also yielded timbers of significant commercial value [2].

Alstonia scholaris (L.) R. Br., also known as Hoa Sữa, Mò Cua, Mù Cua, or Mồng Cua, and Cây Sữa, is a tropical evergreen plant, belonging to the genus *Alstonia*. It is native to Asia regions such as China (Guangxi, Yunnan), the Indian subcontinent (India, Nepal, Sri Lanka), and various Southeast Asian countries, including Thailand, Cambodia, Vietnam, Myanmar, Malaysia, Indonesia, Papua New Guinea, the Philippines, and Australia [3]. In traditional medicine, *A. scholaris* is a medicinal herb used to treat various conditions, including diarrhea, digestive disorders, fever, menstrual irregularities, and skin inflammation caused by vitamin B1 deficiency [3].

Phytochemical studies have revealed that *A. scholaris* contains a wide range of compounds, including alkaloids, iridoids, tannins (classified under the pyrogallic tannin group), flavonoids, coumarins, anthraquinones, glycosides, saponins, and fatty acids [3]. The leaves contain betulin, a precursor for synthesizing betulinic acid, demonstrating significant biological activity in treating HIV and cancer. Furthermore, the leaves contained additional compounds such as alschomine, isoalschomine, picraline, areline, icrarinal, losbanine, scholaricine, and langunamine [3]. The barks are rich in various alkaloids, including ditamine, echitenine, and echitamine, which have been utilized as alternatives to quinine for their antipyretic (fever-reducing) properties. The flowers and roots also contained compounds such as diacetyl picraline, picrinine, strictamine, tetrahydroalstonine, lupeol, ursolic acid, palmitic acid, and amyrin [3]. In this study, we developed a procedure for the isolation and structural identification of typical

compounds derived from *A. scholaris*.

2. EXPERIMENTAL AND RESEARCH METHODS

2.1. Chemicals and Equipment

2.1.1. Plant material

A. scholaris was collected from Yen Phong, Bac Ninh in late February 2016. The voucher specimen AS-02-16 is currently preserved at the Faculty of Chemistry, University of Science, Vietnam National University, Hanoi.

2.1.2. Chemicals and Equipment

The solvents *n*-hexane, CH_2Cl_2, EtOAc, and MeOH (> 95% purity, China) are of column chromatography grade and were dried over Na_2SO_4 before use. Concentrated H_2SO_4 (98%) and anhydrous $FeCl_3$ are of pure analytical grade.

Thin-layer chromatography (TLC) was conducted on pre-coated DC-Alufolien 60 F254 plates (Merck, Germany). Compound spots were visualized under UV light at a wavelength of 254 nm or by using color-developing reagents such as vanillin/H_2SO_4 (1% w/v) or $FeCl_3$/EtOH (ethanol), (5% w/v), followed by heating at 120 °C until the color developed. Column chromatography (CC) was performed using glass columns (Sigma-Aldrich, USA) with silica gel adsorbents of particle sizes 200-500, 63-200, and 40-63 μm (Merck) and Diaion HP-20 adsorbent (Mitsubishi Chemicals, Japan).

Electrospray ionization mass spectrometry (ESI-MS) spectra were acquired using an Agilent Ion Trap LC-MSD-Trap-SL instrument. Nuclear magnetic resonance (NMR) spectra, including ^{1}H-NMR, ^{13}C-NMR, and DEPT, were obtained using a Bruker Avance 500 MHz spectrometer (USA) with tetramethylsilane (TMS) as the internal standard. The measurement solvents employed were $CDCl_3$ and D_2O.

The structures of organic compounds were elucidated using nuclear magnetic resonance (NMR) spectroscopy techniques. In the proton nuclear magnetic resonance (^{1}H-NMR) spectra, the chemical shifts (δ_H) and coupling constants (J) of the signals were determined. Additionally, carbon-13 nuclear magnetic resonance (^{13}C-NMR) spectra, in conjunction with the distortionless enhancement by polarization transfer (DEPT) spectra, were employed to identify the number of carbon atoms (as CH_3, CH_2, CH, or C) in the molecular formula, along with their corresponding chemical shifts (δ_C).

2.2. Experiment

2.2.1. The procedure for preparing the extract from A. scholaris leaves

A. scholaris powdered leaves (2 kg) were macerated with MeOH at room temperature for 3 days and then filtered to obtain the extract. The residue was subsequently macerated twice more with MeOH, using the same solvent volume and duration each time. The filtrates were combined, and the solvent was evaporated under reduced pressure to yield the total MeOH extract (126.7 g). This extract was dissolved in a minimal amount of distilled water and then subjected to sequential partition extraction using the organic solvents *n*-hexane, CH_2Cl_2, and EtOAc, resulting in the corresponding extracts: *n*-hexane (ASLH, 49.9 g), CH_2Cl_2 (ASLD, 45.6 g), and EtOAc (ASLE, 10.4 g). The remaining aqueous solution was concentrated to obtain the water extract (ASLW, 20.8 g).

2.2.2. Isolation of the EtOAc extract from A. scholaris leaves

The ASLE extract (10.4 g) was dissolved in an adequate amount of acetone and mixed with 7 g of silica gel (40-63 μm). After complete drying, it was loaded onto a column pre-packed with silica gel (63-100 μm) using *n*-hexane as the solvent. Column chromatography (CC) was performed with a gradient elution of *n*-hexane-EtOAc in increasing polarity (19:1, 9:1, 6:1, and 3:1, v/v), resulting in five main fractions (ASLE1-ASLE5). Fraction ASLE2 contained needle-like crystals, which were

washed with *n*-hexane and recrystallized from acetone to yield 185.8 mg of pure white crystals. These crystals had an R_f value of 0.29 (TLC, silica gel, *n*-hexane-EtOAc 9:1, v/v) and turned pink, then purple, upon spraying with 1% vanillin/H_2SO_4 reagent. Comparison with a standard on TLC confirmed the crystalline compound as *β*-sitosterol (3). Fraction ASLE4 contained 80 mg of compound **1**, an amorphous white powder with an R_f value of 0.41 (TLC, silica gel, *n*-hexane-EtOAc 3:1, v/v), which turned purple upon spraying with 1% vanillin/H_2SO_4 reagent.

2.2.3. The procedure for preparing the extract from A. scholaris barks

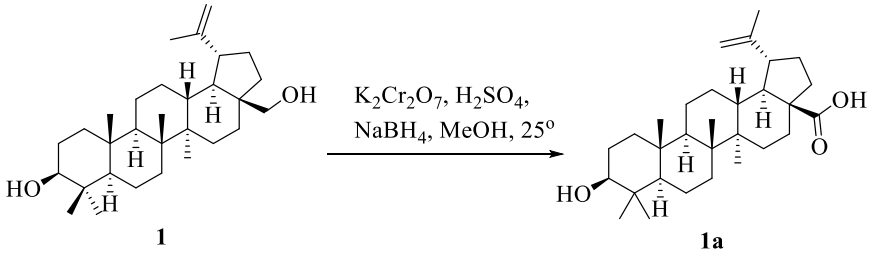
The barks of *A. scholaris*, after collection, were cleaned and dried in the shade for 4 days. They were then fully dried at 40 °C to eliminate fungi and ground into a fine powder. The dried bark powder was soaked in methanol at room temperature for 3 days, followed by filtration to collect the extract. This soaking process was repeated twice more with methanol (each time for 3 days). The filtrates were combined and concentrated using a rotary evaporator under reduced pressure to remove the methanol solvent, yielding the methanol extract (ASBM).

2.2.4. Isolation of MeOH extract from A. scholaris barks

The ASBM extract (2 g) was dissolved in a minimal amount of MeOH and then mixed with 3 g of silica gel (40-63 µm). The mixture was thoroughly stirred to ensure complete adsorption of the sample onto the silica gel, and the solvent was allowed to evaporate at room temperature until fully dry. The silica gel-adsorbed sample was loaded onto a column (2 x 25 cm) pre-packed with silica gel (200-500 µm) using *n*-hexane as the solvent. Sequential elution was performed with solvent systems of *n*-hexane-EtOAc in ratios of 49:1, 29:1, 19:1, 9:1, 6:1, 3:1, and 1:1 (v/v), followed by CH_2Cl_2-MeOH in ratios of 29:1, 15:1, 9:1, 6:1, 3:1, and 1:1 (v/v), resulting in 94 fractions (20 mL each). The fractions were analyzed by TLC, and those with similar chromatographic profiles were combined into 13 main groups (ASBM1-ASBM13). Group ASBM4 (150.6 mg) contained compound 2 as needle-like crystals, which were washed with *n*-hexane and recrystallized from acetone to yield pure white crystals with an R_f value of 0.38 (TLC, silica gel, *n*-hexane-EtOAc 19:1, v/v), turning pinkish-purple upon spraying with 1% vanillin/H_2SO_4 reagent.

Fraction group ASBM6 (63.7 mg) contained needle-like crystals, with spots at R_f values of 0.35 and 0.28 (TLC, silica gel, *n*-hexane-EtOAc 9:1, v/v). These spots exhibited light purple and dark purple colors, respectively, upon spraying with 1% vanillin/H_2SO_4 reagent. Further purification was carried out using Mini-C column chromatography (0.5 x 8 cm) with silica gel adsorbent (40-63 µm), eluting with a gradient of *n*-hexane-EtOAc (29:1, 19:1, 9:1, 3:1, v/v), resulting in 38 fractions (3 mL each). From the third fraction group, 21.8 mg of white needle-like crystals were obtained. TLC analysis identified the compound as *β*-sitosterol, which matched the compound previously isolated from the EtOAc extract of the leaves. Fraction group ASBM12 (200.4 mg) contained compound **4** as white granular particles, which were highly soluble in water.

*2.2.5. Chemical conversion of compound **1** into **1a***



1 **1a**

Figure 1.** Reaction scheme for the conversion of compound **1** into **1a.

Dissolve 50 mg of compound **1** in 8 mL of CH_2Cl_2 and cool the mixture to 0 °C. Next, add 350 mg of $K_2Cr_2O_7$, previously dissolved in 22 mL of distilled water, to the mixture. Slowly introduce

1 mL of concentrated H_2SO_4 dropwise into the reaction mixture. Place the entire reaction mixture on a magnetic stirrer and stir at room temperature for 72 hours. After 72 hours, perform TLC analysis to confirm the completion of the reaction.

2.2.6. Physical constants and spectral data of the isolated compounds

Betulin (**1**): White amorphous powders. R_f = 0.41 (TLC, silica gel *n*-hexane-EtOAc 3:1, v:v), turning purple upon spraying with 1% vanillin/H_2SO_4 reagent. ESI-MS: *m/z* 442 ($C_{30}H_{50}O_2$, $M^{+\cdot}$). ^{1}H-NMR (500 MHz, $CDCl_3$): δ_H (ppm) 0,76 (3H, s, 24-CH_3), 0,82 (3H, s, 25-CH_3), 0,93 (3H, s, 27-CH_3), 0,97 (3H, s, 23-CH_3), 1.02 (3H, s, 26-CH_3), 1.68 (3H, s, 29-CH_3), 3.0 (1H, ddd, *J* = 10.5 Hz, 10.5 Hz, 5,0 Hz, H-20), 3.19 (1H, m, H-3), 3.33 (1H, d, *J* = 11.0 Hz, H-28a), 3.80 (1H, dd, *J* = 11.0 Hz, 1.5 Hz, H-28b), 4.58 (1H, s, H-30), 4.68 (1H, d, *J* = 1.5 Hz, H-30b). ^{13}C-NMR/DEPT (125 MHz, $CDCl_3$): δ_C (ppm) 14.8 (C-27), 15.4 (C-24), 16.0 (C-26), 16.1 (C-25), 18.3 (C-6), 19.1 (C-29), 20.9 (C-11), 25.3 (C-12), 27.1 (C-15), 27.3 (C-2), 28.0 (C-23), 29.2 (C-16), 29.8 (C-21), 33.9 (C-22), 34.3 (C-7), 37.3 (C-10), 37.3 (C-13), 38.7 (C-1), 38.9 (C-4), 40.9 (C-8), 42.7 (C-14), 47.8 (C-17), 47.8 (C-19), 48.8 (C-18), 50.4 (C-9), 55.3 (C-5), 60.6 (C-28), 79.0 (C-3), 109.7 (C-30), 150.5 (C-20).

Betulinic acid (**1a**): White amorphous powders. R_f = 0.30 (TLC, silica gel, *n*-hexane-EtOAc 3:1, v:v), turning purple upon spraying with 1% vanilin/H_2SO_4 reagent. ESI-MS: *m/z* 455 ($C_{30}H_{48}O_3$, $(M-1)^{+\cdot}$). ^{1}H-NMR (500 MHz, $CDCl_3$): δ_H (ppm) 0.75 (3H, s, 24-CH_3), 0.83 (3H, s, 25-CH_3), 0.95 (3H, s, 27-CH_3), 0.96 (3H, s, 23-CH_3), 0.98 (3H, s, 26-CH_3), 1.71 (3H, s, 29-CH_3), 2.38 (1H, ddd, *J* = 11.0 Hz, 11.0 Hz, 6.0 Hz, H-20), 3.16 (1H, dd, *J* = 8.5 Hz, 7.5 Hz, H-3), 4.60 (1H, s, H-30a), 4.73 (1H, s, H-30b), 7.42 (1H, s, HO-28).

***β*-Amyrin** (**2**): White needle-like crystals. R_f = 0.38 (TLC, silica gel *n*-hexane-EtOAc 19:1, v:v), turning purple upon spraying with 1% vanilin/H_2SO_4 reagent. ^{1}H-NMR (500 MHz, $CDCl_3$): δ_H (ppm) 0.79 (3H, s, 24-CH_3), 0.83 (3H, s, 28-CH_3), 0.87 (6H, s, 29-CH_3), 0.94 (3H, s, 25-CH_3), 0.97 (3H, s, 26-CH_3), 0.99 (3H, s, 23-CH_3), 1.14 (3H, s, 27-CH_3), 3.22 (1H, dd, *J* = 4.5 Hz, 11.5 Hz), 5.19 (1H, br s, H-12).

***β*-Sitosterol** (**3**): White needle-like crystals. Melting point 135-136 ^oC. R_f = 0.29 (TLC, silica gel *n*-hexane-EtOAc 9:1, v/v), turning dark purple upon spraying with 1% vanilin/H_2SO_4 reagnet. IR: ν_{max} (cm^{-1}): 3348 (-OH), 1462 (C=C-arene).

Sucrose (**4**): White granular crystals. ^{1}H-NMR (500 MHz, D_2O): δ_H (ppm) 3.41 (1H, t, *J* = 5.0 Hz, H-4), 3.49 (1H, d, *J* = 5.5 Hz, H-2), 3.62 (2H, s, H-1'), 3.69 (1H, t, *J* = 7.0 Hz, H-3), 3.75-3.82 (6H, m, H-5, H-5', 2H-6, 2H-6'), 3.98 (1H, t, *J* = 7.5 Hz, H-4'), 4.16 (1H, d, *J* = 8.3 Hz, H-3'), 5.36 (1H, s, H-1). ^{13}C-NMR (125 MHz, $CDCl_3$): δ_C (ppm) 60.1 (C-6), 61.3 (C-1'), 62.3 (C-6'), 69.2 (C-4'), 71.1 (C-2), 72.4 (C-5), 72.6 (C-3), 73.9 (C-4'), 76.4 (C-3'), 81.4 (C-5'), 92.2 (C-1), 103.7 (C-2').

3. RESULTS AND DISCUSSION

3.1. Isolation of compounds 1-4 and semi-synthesis of compound 1a

Column chromatography on silica gel, employing various elution systems, resulted in the isolation of four compounds from the *A. scholaris* collected in Vietnam. Two compounds, the triterpenoid **1** and the sterol **3**, were isolated from the EtOAc extract of the leaves of this species. In contrast, the triterpenoid **2**, sterol **3**, and sugar **4** were obtained from the MeOH extract of the bark. Compounds **1-4** were isolated as either amorphous or crystalline solids in the elution solvents. The polar nature of these compounds was indicated by the presence of hydroxyl, carboxylic acid, and glucopyranosyl (Glc) groups.

Compound **1a** (22.6 mg, yield 43.8%) was synthesized from compound **1** through an oxidation

reaction using $K_2Cr_2O_7$ in a medium of $NaBH_4$, MeOH, and H_2SO_4. The structures of the studied compounds were determined based on TLC analysis in comparison with standard substances, as well as through mass spectrometry and NMR spectral data analysis.

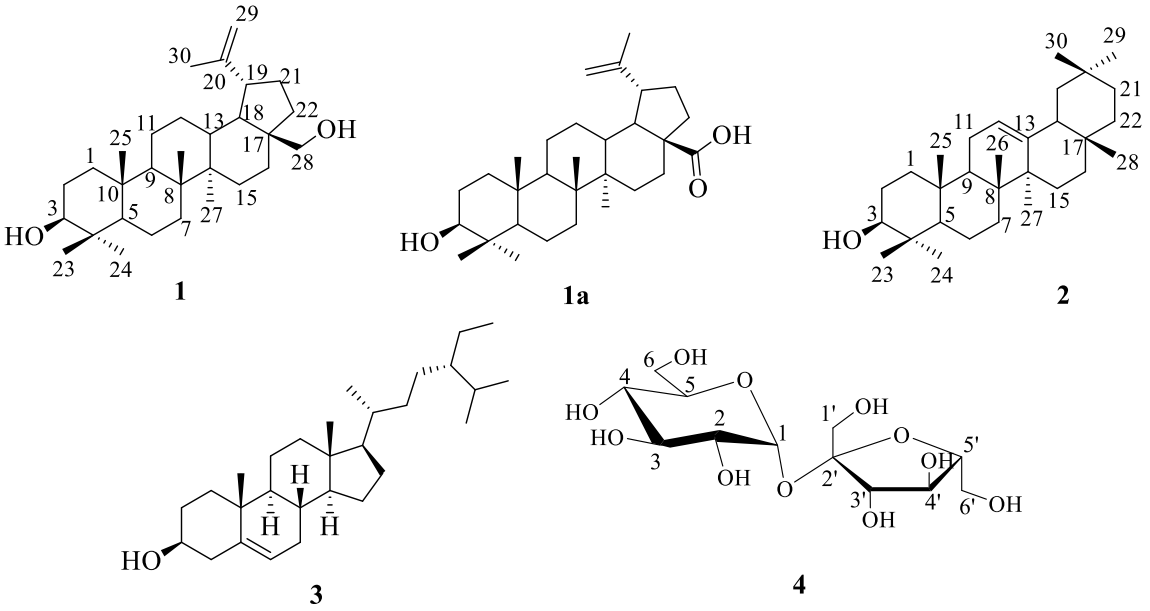


Figure 2. *Structures of compounds* ***1-4*** *and* ***1a.***

3.2. Structural determination of compounds 1-4 and 1a

The ^{1}H-NMR spectrum ($CDCl_3$) of **1** displayed resonance signals corresponding to the following groups: an oxymethine group [δ_H 3.19 (m)], a hydroxymethyl group [δ_H 3.80 (1H, dd, J = 11 Hz, 1.5 Hz) and 3.33 (1H, dd, J = 11.0 Hz, 1.5 Hz)], an isopropenyl group [δ_H 4.58 (1H, s) and 4.68 (1H, d, J = 1.5 Hz)], and five tertiary methyl groups [δ_H 0.76 (3H, s), 0.82 (3H, s), 0.93 (3H, s), 0.97 (3H, s), and 1.02 (3H, s)]. The ^{13}C-NMR and DEPT spectra ($CDCl_3$) of **1** aided by the ^{1}H-NMR data, supporting the structure of a pentacyclic triterpenoid featuring an oxymethine group (δ_C 79.0), a hydroxymethyl group (δ_C 60.6), an isopropenyl group (δ_C 19.1), five methyl groups (δ_C 14.8, 15.4, 16.0, 16.1, and 28.0), ten methylene groups (δ_C 18.3, 20.9, 25.3, 27.1, 27.3, 29.2, 29.8, 33.9, 34.3, and 38.7), five methine groups (δ_C 37.3, 47.8, 48.8, 50.4, and 55.3), and signals for five quaternary carbons (δ_C 37.3, 38.9, 40.9, 42.7, and 47.8). Based on the MS and NMR spectral data, a lupan skeleton was proposed for **1**. The presence of a hydroxymethyl group and an isopropenyl group suggests that a methyl group and an isopropyl group of the lupan skeleton were modified to form lup-20(30)-ene. The ^{1}H-NMR and ^{13}C-NMR data of **1** are fully consistent with those of betulin [4]. Recent clinical studies have demonstrated that betulin is effective against a range of tumors. Betulin exhibited cytotoxic activity and inhibited the growth of certain cancer cell lines [5].

Compound **1a** was obtained as white amorphous powders with an R_f value of 0.30 (TLC, silica gel, *n*-hexane-EtOAc 3:1, v/v), which turned purple upon treatment with 1% vanillin/H_2SO_4 reagent. The ESI-MS spectrum of compound **1a** exhibited a pseudomolecular ion peak [$(M-1)^+$, *m/z* 455], corresponding to a triterpenoid with the molecular formula $C_{30}H_{48}O_3$. This suggests that **1a** is likely a pentacyclic triterpenoid containing a double bond in its structure. The ^{1}H-NMR spectrum of **1a** confirmed the structure of a pentacyclic triterpenoid, featuring an oxymethine group (δ_H 3.16, dd, J = 8.5 Hz, 7.5 Hz), a carbonyl group (δ_H 7.42 (1H, s), an isopropenyl group [δ_H 4.60 (1H, s) and 4.73 (1H, s)], and five tertiary methyl groups [δ_H 0.75 (3H, s), 0.83 (3H, s),

0.95 (3H, s), 0.96 (3H, s), and 0.98 (3H, s)]. Based on the ESI-MS and ^{1}H-NMR spectral data, the structure of **1a** was identified as betulinic acid [6]. In the same manner, compound 1a has a potential in anticancer treatments since it could inhibit the growths of various cancer types, such as melanoma, lung carcinoma, colon cancer, and ovarian cancer [5]. In addition, betulinic acid is most highly regarded for its anti-HIV-1 activity with the underlying mechanism of action via disrupting viral fusion to the cell in a post-binding step through interaction with the viral glycoprotein GP41 [7].

Compound **2** was isolated as white needle-shaped crystals with an R_f value of 0.38 (TLC, silica gel, *n*-hexane-EtOAc 19:1, v/v), which turned pinkish-purple upon treatment with 1% vanillin/H_2SO_4 reagent. The ^{1}H-NMR spectrum ($CDCl_3$) of **2** exhibited resonance signals corresponding to the following proton groups: a trisubstituted double bond [δ_H 5.19 (1H, br s)], an oxymethine group [δ_H 3.22 (1H, dd, J = 4.5 Hz, 11.5 Hz)], and eight tertiary methyl groups [δ_H 0.79 (3H, s), 0.83 (3H, s), 0.87 (6H, s), 0.94 (3H, s), 0.97 (3H, s), 0.99 (3H, s), and 1.14 (3H, s)]. Based on comparison with reference data, compound **2** was identified as the triterpenoid *β*-amyrin [8, 9].

Compound **3** was isolated as white needle-shaped crystals with an R_f value of 0.29 (TLC, silica gel, *n*-hexane-EtOAc 9:1, v/v) and exhibited a deep purple color upon spraying with 1% vanillin/H_2SO_4 reagent. It was identified as *β*-sitosterol through TLC comparison and IR spectroscopy using a standard *β*-sitosterol sample. This compound was detected in both the leaves and bark of the *A. scholaris*.

Compound **4** was isolated as colorless granular crystals. The ^{1}H-NMR spectrum (D_2O) of **4** displayed signals corresponding to fructose [δ_H 3.62 (2H, m), 3.76 (2H, m), 3.79 (1H, m), 3.98 (1H, t), 4.16 (1H, m)] and glucose [δ_H 3.41 (1H, t), 3.49 (1H, t), 3.76 (2H, m), 3.82 (1H, m), 5.35 (1H, s)], which are linked by a glycosidic bond between C-1 and C-2'. The ^{13}C-NMR spectrum (D_2O) of **4** also revealed six carbon signals for α-glucose [δ_C 60.1; 69.2; 71.1; 72.4; 72.6; 92.2] and six carbon signals for *β*-fructose (δ_C 61.3, 62.3, 73.9, 76.4, 81.4, and 103.7). The *α*-1 and *β*-2 linkage was confirmed by the downfield shift of C-2' (δ_C 103.7) and C-1 (δ_C 92.2). By comparing the spectral data with reference literature, the compound was identified as a free sugar molecule named sucrose [10, 11].

4. CONCLUSIONS

This phytochemical study developed an extraction and fractionation protocol for isolating organic compounds from *A. scholaris* leaves and barks. The TLC was employed to preliminarily identify the components in these extracts. Using column chromatography, flash chromatography, and recrystallization techniques, betulin and *β*-sitosterol were isolated from the leaves of the *Alstonia scholaris*, while *β*-amyrin, sucrose, and *β*-sitosterol were obtained from its bark. Through an oxidation-reduction process, betulin was transformed into betulinic acid, a compound known for its anticancer and anti-HIV properties. The structures of the isolated compounds were elucidated using IR spectroscopy, ESI-MS, ^{1}H-NMR, ^{13}C-NMR, and DEPT analyses.

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TÓM TẮT

Phân lập và xác định cấu trúc các hợp chất từ cây Sữa - *Alstonia scholaris* (L.) R. Br. (Apocynaceae) thu hái tại Việt Nam

*Cây Sữa, có tên khoa học Alstonia scholaris (L.) R. Br., là một loài thực vật nhiệt đới thường xanh thuộc chi Hoa sữa, họ La bố ma (Apocynaceae). Lần đầu tiên, nghiên cứu thành phần hóa học cây này thu hái tại Việt Nam được thực hiện trong nghiên cứu này. Bằng kỹ thuật phân tách sắc ký cột silica gel, một triterpenoid betulin (**1**) và một sterol β-sitosterol (**3**) được tìm thấy trong cao chiết ethyl acetate (EtOAc) lá. Trong khi đó, phân lập cao chiết methanol (MeOH) vỏ cây thu được một triterpenoid β-amyrin (**2**), một sterol β-sitosterol (**3**) và một hợp chất đường tự do sucrose (**4**). Oxi hóa hợp chất 1 bằng tác nhân $K_2Cr_2O_7$ trong môi trường acid cho dẫn xuất betunic acid (**1a**) với hiệu suất 43.8%. Cấu trúc của các hợp chất này được xác định thông qua phân tích dữ kiện quang phổ.*

Từ khóa: Apocynaceae; *Alstonia scholaris*; Triterpenoid; Sterol; Đường.