A new alkaloid from *Salsola collina*

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Abstract: *Salsola collina* is widely distributed in droughty and semi-droughty area, which is used as a kind of folk remedy in traditional Chinese medicine for treatment of hypertension. The study is on the chemical constituents of this herb from its aerial parts to obtain its active constituents. Dried and crushed aerial parts of this herb were extracted three times with 95% EtOH at reflux. The ethanol extracts were combined and concentrated under reduced pressure at 70 ℃ to yield residue, which was suspended in water and successively partitioned with light petroleum, chloroform and *n*-butanol. The chloroform and *n*-butanol fractions were treated by various chromatographic techniques, such as silica gel, C_{18} reversed-phase silica gel and macroporous resin column chromatography. Compounds were elucidated by their physicochemical properties and spectroscopic analysis. In the course of our study on searching biological active components from this herb, a new alkaloid together with three known alkaloids were isolated and identified as *N*-transferuloyl-3-methyldopamine (**1**), 3-[4-(β-*D*-glucopyranosyloxy)-3-methoxyphenyl]-*N*-[2-(4-hydroxyl-3-methoxyphenyl) ethyl]-2-propenamide (**2**), salsoline A (**3**), salsoline B (**4**). Compound **4** is a new compound and named as salsoline B, while compound **2** was obtained in *Salsola collina* for the first time.

Key words: *Salsola collina*; alkaloids; salsoline B

CLC number: R284.1; R284.2 **Document code:** A **Article ID:** 0513 - 4870(2007)06 - 0618 - 03

猪毛菜中一新生物碱

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摘要: 研究猪毛菜中的生物碱。采用各种色谱技术进行分离,通过理化性质及波谱分析进行结构鉴定。从猪毛菜地上部分的95%乙醇提取物中分离得到4个酰胺类生物碱,其化学结构分别确定为*N*-反式阿魏酰基-3-甲基多巴胺(**1**)、3-[4-(β-*D*-吡喃葡糖氧基)-3-甲氧基苯基]-*N*-[2-(4-羟基-3-甲氧基苯基)乙基]-2-丙胺(**2**),猪毛菜碱A(**3**),猪毛菜碱B(**4**)。化合物**4**为一新化合物,命名为猪毛菜碱B,化合物**2**为首次从该属植物中分离得到。

关键词: 猪毛菜; 生物碱; 猪毛菜碱B

Salsola collina Pall. is a plant of the Chenopodiaceae found throughout Northern China and other adjacent countries, which is used as a kind of folk remedy in traditional Chinese medicine for treatment of hypertension[1]. This plant has been known to contain alkaloids, sterols and flavonoids[2-4]. The alkaloids of the plant have not been reported systematically. The present study deals with the structure elucidation of a new alkaloid by their physicochemical properties and spectral data, along with three known alkaloids from the aerial part of this plant.

Received date: 2006-10-23.

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Results and discussion

Compound **4**, light purple crystal (Me_2CO), mp 257 - 259 ℃, with a molecular formula $C_{12}H_{13}NO_3$, supported by its ESI-MS: *m/z* 218[M - H]$^-$. The ^1H and ^{13}C NMR data of **4** (Table 1) were very similar to that of **3**, salsoline A, and the difference was that the aromatic hydrogen signals were different on each spectrum. In ^1H NMR of compound **3**, there were two aromatic hydrogen signals and they were singlets, while in ^1H NMR of compound **4**, there were two aromatic hydrogen signals and they were doublets (J = 8.0 Hz), which indicating that the position for each hydrogen on the aromatic ring is adjacent. The chemical shift of C-10a in ^{13}C NMR spectrum of **4** was δ 124.8 and it correlated with hydroxyl at δ 8.36 on HMBC spectrum (Table 1), so the hydroxyls for compound **4** were on 9- and 10-position. As a result, the structure for compound **4** was (10bs)-1, 2, 3, 5, 6, 10b-hexahydropyrrolo [2, 1-a]-9, 10-dihydroxy isoquinoline-3-one. It is an isomeric compound for compound **3**, and it is a new compound, named as salsoline B (Figure 1).

Table 1 NMR data of compound **4** (in DMSO-d_6, δ)

Position	δ_C	δ_H (J, Hz)	HMBC(C→H)	DEPT
1α	27.4	1.60(m)	H-2, 10b	CH_2
β		2.80(m)		
2α	31.0	2.20(m)	H-1	CH_2
β		2.40(m)		
3	172.0		H-1, 2, 5α, 10b	
4				
5α	36.4	2.75(m)	H-6	CH_2
β		4.08(m)		
6	28.2	2.55(2H, m)	H-5, 7	CH_2
6a	124.6		H-5, 6, 7, 8, 10b	
7	119.0	6.40(d, 8)	H-6, 8	CH
8	113.6	6.62(d, 8)	H-7, OH	CH
9	142.9	9.14(OH)	H-7, 8, OH	
10	142.1	8.36(OH)	H-8, 10b, OH	
10a	124.8		H-7, 6, 10b, 1α, OH	
10b	54.5	4.73(dd, 7, 9)	H-1, 2α, 5β	CH

Experimental

All melting points were determined by a XT-4 micromelting point apparatus and are uncorrected. IR spectra were recorded by an FTIR-8900 (KBr) IR spectrometer. ^1H, ^{13}C and 2D NMR spectra were recorded in DMSO-d_6 on Bruker AV-500 spectrometer with TMS as internal standard and values were given in

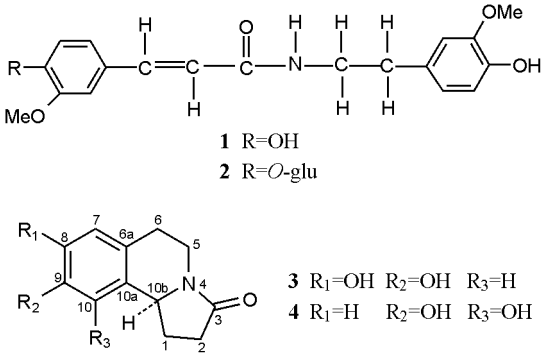

Figure 1 The structures of compounds **1** - **4**

ppm (δ). MS spectra were performed on a Micromass Qauttro micro instrument. All solvents used were of analytical grade. Silica gel (100 - 200 mesh and 200 - 300 mesh), macroporous resin D101 (Shanghai, China) and C_{18} reversed-phase silica gel (250 mesh, Merck) were used for column chromatography, and precoated silica gel GF_{254} plates (Qingdao Haiyang Chemical Plant, Qingdao, China) were used for TLC.

Plant material The aerial parts of *Salsola collina* Pall. were collected from Zhou county of Shandong Province, China, in July 2005, and identified by Prof. LI You-bin (Department of Phytochemistry, Jiangsu Provincial Academy of Traditional Chinese Medicine). Voucher specimen (No. 2005-3) is deposited in the herbarium of Jiangsu Provincial Academy of Traditional Chinese Medicine.

Extraction and isolation Twenty five kg dried and crushed aerial parts of *S. collina* were extracted three times with 95% EtOH at reflux. The ethanolic extracts were combined and concentrated under reduced pressure at 70 ℃ to yield 1.4 kg of residue, which was suspended in water and successively partitioned with light petroleum, chloroform, and *n*-butanol. The chloroform fraction (35 g) was subjected to silica gel 500 g (80 cm × 7.5 cm) column chromatography, eluting with a stepwise gradient of petroleum ether-Me_2CO (20∶1 to 1∶1) to yield 30 fractions, which were combined on the basis of TLC. Compounds **1** (25 mg), **3** (18 mg) and **4** (22 mg) were isolated from Fr. 26 (petroleum ether-Me_2CO 4∶1) and Fr. 29 (petroleum ether-Me_2CO 2∶1), and then purified by Sephadex LH-20. The *n*-butanol fracion (700 g) was dissolved in water and chromatographed over macroporous resin D101 column eluting with water, 10% EtOH, 50% EtOH, 75% EtOH, and 95% EtOH. The 50% EtOH extract

(124 g) was subjected to silica gel 1 240 g (80 cm × 8.5 cm) column chromatography, eluting with a stepwise gradient of $CHCl_3$-MeOH (98∶2 to 1∶1) to yield 16 fractions, which were combined on the basis of TLC. Compound **2** (10 mg) was isolated from Fr. 9 ($CHCl_3$-MeOH 80∶20), and then chromatographed over reversed phase RP-18 chromatography (MeOH-H_2O 40% to 100%).

Structure identification

Compound 1 A light yellow square crystal (Me_2CO), mp 105 - 106 ℃, ESI-MS: 342[M - H]$^-$. ^{1}H NMR (DMSO-d_6, 300 MHz) δ: 9.37(1H, s, 4′-OH), 8.66(1H, s, 4-OH), 7.94(1H, t, J = 6 Hz, -NH), 7.31(1H, d, J =16 Hz, H-7′), 7.11(1H, d, J =2 Hz, H-2′), 6.98(1H, dd, J =2, 8 Hz, H-6′), 6.81(1H, d, J =8 Hz, H-5′), 6.78(1H, d, J =2 Hz, H-2), 6.68(1H, d, J =8 Hz, H-5), 6.60(1H, dd, J =2, 8 Hz, H-6), 6.43(1H, d, J =16 Hz, H-8′), 3.81(3H, s, -OCH_3′), 3.73(3H, s, -OCH_3), 3.37(2H, m, H-8), 2.66(2H, t, J =7 Hz, H-7). ^{13}C NMR (DMSO-d_6, 75 MHz) δ: 165.3(C-9′), 148.2(C-4′), 147.8(C-3′), 138.8(C-7′), 130.2(C-1), 126.4(C-1′), 121.4(C-6′), 120.7(C-6), 119.0(C-8′), 115.6(C-5′), 115.3(C-5), 112.8(C-2), 110.8(C-2′), 147.4(C-3), 144.8(C-4), 55.5(OCH_3), 55.5(OCH_3′), 40.2(C-8), 34.7(C-7). These data were identical to the literature values of *N*-transferuloyl-3-methyldopamine[2].

Compound 2 A white crystal (MeOH), mp 168 - 170 ℃. ESI-MS: 528[M + Na]$^+$. ^{1}H NMR (DMSO-d_6, 500 MHz) δ: 8.66(1H, s, 4-OH), 7.98(1H, t, J = 6 Hz, -NH), 7.34(1H, d, J =16 Hz, H-7′), 7.16(1H, d, J =2 Hz, H-2′), 7.10(1H, d, J =8 Hz, H-5′), 7.07(1H, dd, J =2, 8 Hz, H-6′), 6.77(1H, d, J =2 Hz, H-2), 6.68(1H, d, J =8 Hz, H-5), 6.60(1H, dd, J =2, 8 Hz, H-6), 6.53(1H, d, J =16 Hz, H-8′), 4.96(1H, d, J =7 Hz, H-1″), 3.80(3H, s, -OCH_3′), 3.74(3H, s, -OCH_3), 3.37(2H, m, H-8), 2.66(2H, t, J = 7 Hz, H-7). ^{13}C NMR (DMSO-d_6, 125 MHz) δ: 165.0(C-9′), 149.0(C-4′), 147.6(C-3′), 147.3(C-3), 144.7(C-4), 138.2(C-7′), 130.1(C-1), 128.8(C-1′), 120.9(C-6′), 120.6(C-6), 120.4(C-8′), 115.3(C-5′), 115.1(C-5), 112.7(C-2), 110.8(C-2′), 99.7(C-1″), 77.0(C-5″), 76.8(C-3″), 73.1(C-2″), 69.5(C-4″), 60.4(C-6″), 55.6(OCH_3′), 55.5(OCH_3), 40.4(C-8), 34.7(C-7). Via comparison with the literature[2], compound **2** was identified as 3-[4-(β-*D*-glucopyranosyloxy)-3-methoxyphenyl]-*N*-[2-(4-hydroxyl-3-methoxyphenyl) ethyl]-2-propenamide.

Compound 3 A light purple crystal (Me_2CO), mp 257 - 259 ℃, ESI-MS: 218[M - H]$^-$. ^{1}H NMR (DMSO-d_6, 500 MHz) δ: 8.81(1H, s, 9-OH), 8.77(1H, s, 8-OH), 6.49(1H, s, H-7), 6.48(1H, s, H-10), 4.57(1H, dd, J = 8, 8 Hz, H-10b), 3.96(1H, m, H-5β), 2.92(1H, m, H-5α), 2.55(3H, m, H-6, 1β), 2.39(1H, m, H-2β), 2.20(1H, m, H-2α), 1.60(1H, m, H-1α). ^{13}C NMR (DMSO-d_6, 125 MHz) δ: 171.7(C-3), 143.9(C-9), 143.7(C-8), 128.1(C-10a), 123.4(C-6a), 115.1(C-7), 111.4(C-10), 55.3(C-10b), 36.3(C-5), 30.9(C-2), 27.1(C-6), 27.0(C-1). These data were in excellent accordance with the literature values of salsoline A[2].

Compound 4 A light purple crystal (Me_2CO), mp 248 - 250 ℃, ESI-MS: 218[M - H]$^-$. IR(KBr) cm^{-1}: 3 320(OH), 2 975, 2 906(CH), 1 650(C=O), 1 615, 1 500(Ar). ^{1}H NMR and ^{13}C NMR spectral data are shown in Table 1.

Aknowledgements: We thank Dr. Shen Wen-bin from China Pharmaceutical University for the NMR spectra.

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