昆明柏化学成分研究

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［摘要］ **目的**：研究昆明柏 *Sabina gaussenii* 枝叶中的化学成分。**方法**：应用硅胶，羟丙基葡聚糖凝胶（Sephadex LH-20），RP-18，MCI-gel 柱色谱和半制备 HPLC 等手段进行分离纯化；根据理化性质和波谱学方法鉴定化合物的结构。**结果**：从昆明柏枝叶乙醇提取物的乙酸乙酯萃取部位中分离得到 7 个化合物，分别鉴定为（7*S*，8*R*）-dihydro-3-hydroxy-8-hydroxy-methyl-7-（4-hydroxy-3-methoxyphenyl）-1-benzofuranpropanol（**1**），（8*R*，8′ *S*，7*S*）-4′-（3″-methoxyrhamnopyranosyl）oxy-8′-hydroxy-3，3′，4-trimethoxy-8-hydroxymethyl-lign-7-9′-lactone（**2**），7*S*，8*R-erythro*-4，7，9，9′-tetrahydroxy-3，3′-dimethoxy-8-*O*-4′-neolignan（**3**），7*S*，8*S-threo*-4，7，9，9′-tetrahydroxy-3，3′-dimethoxy-8-*O*-4′-neolignan（**4**），leucoseceptoside A（**5**），焦地黄苯乙醇苷 D（**6**），blumenol A（**7**）。**结论**：化合物 **1**～**7** 均为首次从该植物中分离得到。

［关键词］ 柏科；昆明柏；化学成分；木脂素
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Chemical Constituents of *Sabina gaussenii*

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［**Abstract**］ **Objective**: To study the chemical constituents from the branches and leaves of *Sabina gaussenii*. **Method**: Silica gel, Sephadex LH-20, RP-18, MCI-gel column chromatography, semi-preparative HPLC and other means were used to isolate an purify the constituents, the structures of the compounds were identified by physicochemical properties and spectral data. **Result**: Seven compounds were obtained from the ethyl acetate fraction of ethanol extract in the branches and leaves of *S. gaussenii* and identified as (7*S*, 8*R*) -dihydro-3-hydroxy-8-hydroxy-methyl-7- (4-hydroxy-3-methoxyphenyl) -1-benzofuranpropanol (**1**), (8*R*, 8′*S*, 7*S*) -4′-(3″-methoxyrhamnopyranosyl) oxy-8′-hydroxy-3, 3′, 4-trimethoxy-8-hydroxymethyl-lign-7-9′-lactone (**2**), 7*S*, 8*R-erythro*-4, 7, 9, 9′-tetrahydroxy-3, 3′-dimethoxy-8-*O*-4′-neolignan (**3**), 7*S*, 8*S-threo*-4, 7, 9, 9′-tetrahydroxy-3, 3′-dimethoxy-8-*O*-4′-neolignan (**4**), leucoseceptoside A (**5**), coke to yellow benzene glycosides D (**6**), and blumenol A (**7**). **Conclusion**: Compounds **1-7** were all obtained from *S. gaussenii* for the first time.

［**Key words**］ Cupressaceae; *Sabina gaussenii*; chemical constituents; lignans

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昆明柏又称滇刺柏。柏科圆柏属植物。小乔木,高约 8 m,或为灌木[1]。为我国特有树种,产于云南昆明、文山等地,生于海拔 1 200 ~ 2 000 m 地带。被用做防治多种疾病的药材,具有广泛的生物活性,如抗肿瘤活性[2]。其作为裸子植物系统化学研究的一部分,也为了寻找新的生物活性成分,本研究对昆明柏枝叶的乙醇提取物的化学成分进行了研究,从中分离鉴定了 7 个化合物,分别是(7*S*,8*R*)-dihydro-3-hydroxy-8-hydroxy-methyl-7-(4-hydroxy- 3-methoxyphenyl)-1-benzofuranpropanol(**1**),(8*R*,8′*S*,7*S*)-4′-(3″-methoxyrhamnopyranosyl) oxy-8′-hydroxy-3, 3′, 4-trimethoxy-8-hydroxymethyl-lign-7-9′-lactone(**2**),7*S*,8*R*-*erythro*-4,7,9,9′-tetrahydroxy-3,3′-dimethoxy-8-*O*-4′-neolignan(**3**),7*S*,8*S*-*threo*-4,7,9,9′-tetrahydroxy-3,3′-dimethoxy-8-*O*-4′-neolignan(**4**),leucoseceptoside A(**5**),焦地黄苯乙醇苷 D(**6**),blumenol A(**7**)。以上 7 个化合物均为首次从该植物中分离得到。

1 材料与仪器

1.1 材料 试验用昆明柏 *Sabina gaussenii* 的枝叶采自中国科学院昆明植物研究所植物园。经成都中医药大学药用植物教研室卢先明教授鉴定为柏科圆柏属植物昆明柏 *S. gaussenii* 的枝叶。

1.2 仪器和试剂 Double-beam 210A 型紫外光谱仪(日本岛津公司);AV-400,Avance III 600 以及 DRX-500 核磁共振仪(Bruker);1200 系列分析型 HPLC(Agilent);半制备、制备 HPLC(塞普锐斯);200 ~ 300 目硅胶(青岛海洋化工厂);MCI gel CHP 20P,75 ~ 150 μm,(日本三菱公司);羟丙基葡聚糖凝胶(Sephadex LH-20, Amersham Biosciences, Sweden);GF254 高效薄层板(青岛海洋化工厂),所有试剂均为分析纯。

2 提取和分离

昆明柏枝叶干样品 4 kg 粉碎后,用 70% 乙醇回流提取 3 次,经浓缩后得到浸膏,悬浮于水中后,用石油醚(60 ~ 90 ℃)萃取,合并石油醚萃取液,回收溶剂,得石油醚部位浸膏;母液继续用乙酸乙酯萃取,合并乙酸乙酯萃取液,回收溶剂,得乙酸乙酯部位浸膏 50 g;母液继续用正丁醇萃取,合并正丁醇萃取液,回收溶剂,得正丁醇部位浸膏。乙酸乙酯部位经 MCI 柱色谱脱色素,硅胶柱以三氯甲烷-甲醇系统,以甲醇浓度梯度为 5% ~ 100% 由低到高反复洗脱,再以 Sephadex LH-20 凝胶柱以三氯甲烷-甲醇(1∶1)纯化,再经半制备型 HPLC 反相柱纯化得到 7 个化合物分别为化合物 **1**(8 mg),**2**(7 mg),**3**(9 mg),**4**(11 mg),**5**(13 mg),**6**(12 mg),**7**(10 mg)。化学结构见图 1。

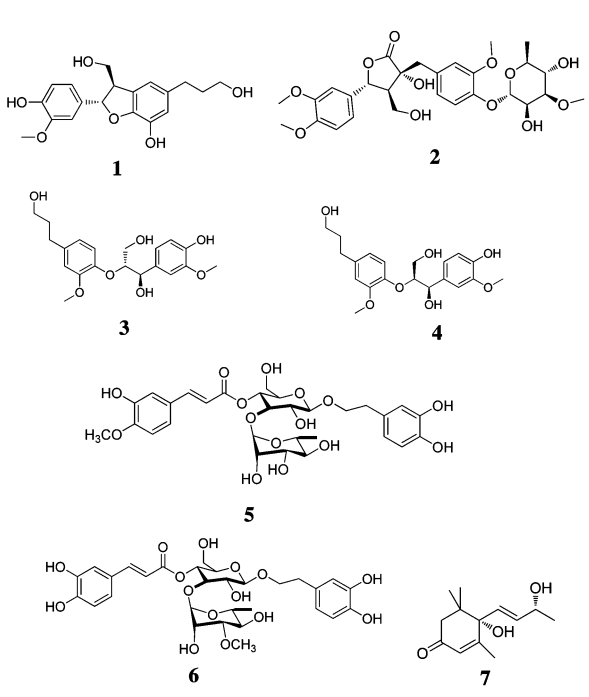

图 1 化合物 1 ~ 7 的化学结构

Fig. 1 Chemical structures of compounds 1-7

3 结构鉴定

化合物 **1** 黄色油状物。^{1}H-NMR(600 MH$_Z$, CD$_3$OD) δ:6.98(1H,d,*J* = 1.6 Hz,H-2),6.84(1H,dd,*J* = 8.2,1.6 Hz H-6),6.76(1H,d,*J* = 8.2 Hz,H-5),6.61(1H,s,H-2′),6.57(1H,s,H-6′),5.49(1H,d,*J* = 6.0 Hz,H-7),3.83(1H,m,H-9),3.81(3H,s,-CH$_3$O),3.75(1H,dd,*J* = 10.8,7.4 Hz,H-9),3.56(2H,t,*J* = 6.4 Hz,H-9′),3.45(1H,dd,*J* = 12.2,6.0 Hz,H-8),2.56(2H,br t,*J* = 7.2 Hz,H-7),1.79(2H,m,H-8′)。^{13}C-NMR(150 Hz,CD$_3$OD) δ:148.6(C-3),146.9(C-4),145.7(C-4′),141.5(C-3′),136.1(C-1′),134.6(C-5′),129.3(C-1),119.2(C-6),116.4(C-6′),116.2(C-2′),115.6(C-5),110.1(C-2),88.2(C-7),64.7(C-9),61.7(C-9′),55.8(-CH$_3$O),55.2(C-8),34.9(C-8′),32.2(C-7′)。以上数据与文献[3]报道基本一致,故鉴定化合物 **1** 为(7*S*,8*R*)-dihydro-3′-hydroxy-8-hydroxy-methyl-7-(4-hydroxy-3-methoxyphenyl)-1′-benzofuranpropanol。

化合物 **2** ^{1}H-NMR(600 MHz,CD$_3$OD) δ:7.06(1H,d,*J* = 8.2 Hz,H-5′),6.97(1H,d,*J* = 1.8 Hz,H-2′),6.86(1H,d,*J* = 8.2 Hz,H-5),6.83(1H,dd,*J* = 8.2,1.8 Hz,H-6′),6.59(1H,dd,*J* = 8.2,1.8

Hz, H-6), 6.40 (1H, d, J = 1.8 Hz, H-2), 5.34 (1H, d, J = 1.6 Hz, H-1″), 5.10 (1H, d, J = 9.2 Hz, H-7), 3.94 (1H, dd, J = 11.4, 7.4 Hz, H-9a), 3.80 (3H, s, 3′-OCH_3), 3.79 (3H, s, 4-OCH_3), 3.63 (3H, s, 3-OCH_3), 3.60 (1H, dd, J = 11.4, 4.8 Hz, H-9b), 3.52 (3H, s, 3″-OCH_3), 3.32 (1H, d, J = 13.2 Hz, H-7′a), 3.05 (1H, d, J = 13.1 Hz, H-7′b), 2.44 (1H, m, H-8), 1.22 (3H, d, J = 6.3 Hz, H-6″), 3.86 ~ 4.28 (4H, m, H-2″ to H-5″)。^{13}C-NMR (150 MHz, CD_3OD) δ: 180.2 (C-9′), 152.1 (C-3′), 151.9 (C-3), 150.5 (C-4), 146.1 (C-4′), 132.7 (C-1′), 132.4 (C-1), 124.5 (C-6′), 120.7 (C-6), 120.1 (C-5′), 116.3 (C-2′), 112.7 (C-5), 110.6 (C-2), 101.7 (C-1″), 82.8 (C-7), 82.0 (C-3″), 79.4 (C-8′), 72.7 (C-4″), 70.9 (C-5″), 68.1 (C-2″), 61.1 (C-9), 60.8 (3″-OCH_3), 58.6 (3′-OCH_3), 57.5 (4-OCH_3), 56.4 (3-OCH_3), 51.7 (C-8), 42.8 (C-7′), 18.1 (C-6″). 以上数据与文献[4]报道基本一致，故鉴定化合物 **2** 为 (8*R*, 8′*S*, 7*S*)-4′-(3″-methoxyrhamnopyranosyl) oxy-8′-hydroxy-3, 3′, 4-trimethoxy-8-hydroxymethyl-lign-7-9′-lactone。

化合物 **3** 无色胶状物。^{1}H-NMR (600 MHz, CD_3OD) δ: 7.00 (1H, d, J = 1.8 Hz, H-2′), 6.82 (1H, dd, J = 8.2, 1.8 Hz, H-5), 6.81 (1H, dd, J = 8.2, 1.8 Hz, H-2), 6.79 (1H, d, J = 1.8 Hz, H-6), 6.73 (1H, d, J = 8.2 Hz, H-5′), 6.66 (1H, d, J = 8.2 Hz, H-6′), 4.85 (1H, d, J = 6.0 Hz, H-7), 4.28 (1H, m, H-8), 3.80 (3H, s, -OCH_3), 3.78 (3H, s, -OCH_3), 3.55 (2H, t, J = 6.5 Hz, H-9′), 2.60 (2H, br t, J = 7.0 Hz, H-7′), 1.81 (1H, m, H-8′)。^{13}C-NMR (150 MHz, CD_3OD) δ: 32.5 (C-7′), 34.3 (C-8′), 55.2 (-OCH_3), 54.3 (-OCH_3), 61.0 (C-9), 62.4 (C-9′), 72.6 (C-7), 85.0 (C-8), 110.2 (C-2), 112.4 (C-2′), 115.0 (C-5), 118.5 (C-5′), 119.2 (C-6), 120.2 (C-6′), 133.1 (C-1), 134.2 (C-1′), 145.3 (C-4), 145.6 (C-4′), 147.0 (C-3), 150.2 (C-3′)。以上数据与文献[5]报道基本一致，故鉴定化合物 **3** 为 7*S*, 8*R*-*erythro*-4, 7, 9, 9′-tetrahydroxy-3, 3′-dimethoxy-8-*O*-4′-neolignan。

化合物 **4** 无色胶状物。^{1}H-NMR (600 MH_Z, CD_3OD) δ: 7.02 (1H, d, J = 8.2 Hz, H-2′), 6.97 (1H, d, J = 8.2 Hz, H-5′), 6.87 (1H, dd, J = 8.2, 1.8 Hz, H-6′), 6.81 (1H, d, J = 8.2 Hz, H-2), 6.76 (1H, d, J = 8.2 Hz, H-5), 6.71 (1H, dd, J = 8.2, 1.8 Hz, H-6), 4.89 (1H, d, J = 6.0 Hz, H-7), 4.20 (1H, dd, J = 9.8, 5.4 Hz, H-8), 3.86 (3H, s, -OCH_3), 3.82 (3H, s, -OCH_3), 3.58 (2H, t, J = 6.5 Hz, H-9′), 2.64 (2H, br t, J = 7.0 Hz, H-7′), 1.83 (1H, m, H-8′。^{13}C-NMR (CD_3OD, 150 MHz) δ: 150.0 (C-3′), 147.5 (C-3), 146.2 (C-4′), 145.3 (C-4), 136.6 (C-1′), 132.1 (C-1), 120.5 (C-6′), 119.1 (C-6), 118.5 (C-5′), 115.7 (C-5), 112.2 (C-2′), 110.5 (C-2), 87.6 (C-8), 72.0 (C-7), 61.2 (C-9′), 60.2 (C-9), 56.2 (-OCH_3), 56.1 (-OCH_3), 33.8 (C-8′), 32.7 (C-7′)。以上数据与文献[5]报道基本一致，故鉴定化合物 **4** 为 7*S*, 8*S*-*threo*-4, 7, 9, 9′-tetrahydroxy-3, 3′-dimethoxy-8-*O*-4′-neolignan。

化合物 **5** 淡黄色胶状物。^{1}H-NMR (600 MHz, CD_3OD) δ: 6.70 (1H, d, J = 1.8 Hz, H-2), 6.68 (1H, d, J = 8.2 Hz, H-5), 6.57 (1H, dd, J = 8.2, 1.8 Hz, H-6), 2.80 (2H, t, J = 7.2 Hz, H-7), 4.04 (1H, m, H-8a), 3.74 (1H, m, H-8b), 4.38 (1H, d, J = 8.0 Hz, H-1′), 3.81 (1H, t, J = 9.0 Hz, H-3′), 4.91 (1H, overlapped, H-4′), 5.19 (1H, d, J = 1.3 Hz, H-1″), 3.92 (1H, m, H-2″), 3.30 ~ 3.80 (6H, m, H-2′, H-5′, H-6′, H-3″, H-4″, H-5″), 1.10 (1H, d, J = 6.2 Hz, H-6″), 7.20 (1H, d, J = 1.8 Hz, H-2‴), 6.82 (1H, d, J = 8.2 Hz, H-5‴), 7.08 (1H, dd, J = 8.2, 1.8 Hz, H-6‴), 7.65 (1H, d, J = 16.0 Hz, H-7‴), 6.38 (1H, d, J = 16.0 Hz, H-8‴), 3.87 (3H, s, 3‴-OCH_3)。^{13}C-NMR (CD_3OD, 150 MHz) δ: 131.2 (C-1), 117.0 (C-2), 146.2 (C-4′), 145.3 (C-4), 116.0 (C-5), 121.1 (C-6), 36.4 (C-7), 72.0 (C-8), 104.0 (C-1′), 76.0 (C-2′), 81.4 (C-3′), 70.0 (C-4′), 75.7 (C-5′), 62.0 (C-6′), 102.9 (C-1″), 72.2 (C-2″), 71.8 (C-3″), 73.6 (C-4″), 70.2 (C-5″), 18.3 (C-6″), 127.5 (C-1‴), 115.0 (C-2‴), 146.5 (C-3‴), 150.2 (C-4‴), 116.4 (C-5‴), 123.0 (C-6‴), 147.9 (C-7‴), 114.6 (C-8‴), 168.2 (C-9‴), 56.3 (-OCH_3) 以上数据与文献[6]报道一致，故鉴定化合物 **5** 为 leucoseceptoside A。

化合物 **6** 淡黄色胶状物。^{1}H-NMR (600 MHz, CD_3OD) δ: 6.74 (1H, d, J = 1.8 Hz, H-2), 6.82 (1H, d, J = 8.2 Hz, H-5), 6.69 (1H, dd, J = 8.2, 1.8 Hz, H-6), 2.81 (2H, br d, J = 2.8 Hz, H-7), 4.06 (1H, m, H-8a), 3.74 (1H, m, H-8b), 4.38 (1H, d, J = 7.8 Hz, H-1′), 3.75 (1H, t, J = 9.0 Hz, H-3′), 4.91 (1H, overlapped, H-4′), 5.19 (1H, br s, H-1″), 3.91 (1H, m, H-2″), 3.30 ~ 3.70 (6H, m, H-2′, H-5′, H-6′, H-3″, H-4″, H-5″), 1.09 (1H, d, J = 6.0 Hz, H-6″), 7.07

(1H, d, J = 14.2 Hz, H-2‴), 6.74 (1H, d, J = 1.8 Hz, H-5‴), 6.96 (1H, dd, J = 8.2, 1.8 Hz, H-6‴), 7.59 (1H, d, J = 16.0 Hz, H-7‴), 6.27 (1H, d, J = 16.0 Hz, H-8‴), 3.81 (3H, s, 4-OCH_3)。^{13}C-NMR (CD_3OD, 150 MHz) δ: 131.1 (C-1), 117.1 (C-2), 146.3 (C-4′), 145.1 (C-4), 116.1 (C-5), 121.1 (C-6), 36.2 (C-7), 72.1 (C-8), 104.1 (C-1′), 76.1 (C-2′), 81.3 (C-3′), 70.1 (C-4′), 75.7 (C-5′), 62.1 (C-6′), 102.7 (C-1″), 72.1 (C-2″), 71.6 (C-3″), 73.4 (C-4″), 70.3 (C-5″), 18.1 (C-6″), 127.5 (C-1‴), 115.0 (C-2‴), 146.4 (C-3‴), 150.1 (C-4‴), 116.2 (C-5‴), 123.0 (C-6‴), 147.7 (C-7‴), 114.5 (C-8‴), 168.1 (C-9‴), 56.3 (-OCH_3) 以上数据与文献[6]报道一致,故鉴定化合物 **6** 为焦地黄苯乙醇苷 D。

化合物 **7** 白色粉末。^{1}H-NMR ($CDCl_3$, 400 MHz) δ: 2.45 (1H, d, J = 16.8 Hz, H-2a), 2.25 (1H, d, J = 16.8 Hz, H-2b), 5.91 (1H, br s, H-4), 5.79 (1H, d, J = 15.7 Hz, H-7), 5.87 (1H, dd, J = 15.7, 5.1 Hz), 4.42 (2H, m, H-9), 1.30 (3H, d, J = 6.3 Hz), 1.02 (3H, s, H-11), 1.11 (3H, s, H-12), 1.90 (3H, br s, H-13)。^{13}C-NMR ($CDCl_3$, 100 MHz) δ: 41.1 (C-1), 49.7 (C-2), 197.9 (C-3), 127.0 (C-4), 162.6 (C-5), 79.1 (C-6), 135.7 (C-7), 129.0 (C-8), 68.0 (C-9), 23.7 (C-10), 22.9 (C-11), 24.0 (C-12), 18.9 (C-13), 上述数据与文献[7]报道一致,故鉴定化合物 **7** 为 blumenol A。

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