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黄桐枝叶的化学成分研究

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摘 要: 为研究黄桐(*Endospermum chinense* Benth.)的化学成分,运用柱层析等分离纯化方法从黄桐枝叶中分离得到13个化合物:pubinernoid A(**1**)、(*E*)-linalool-1-oic acid(**2**)、(+)-去氢催吐萝芙木醇(**3**)、3α-hydroxy-5,6-epoxy-7-megastigmen-9-one(**4**)、齐墩果酸(**5**)、3-羰基齐墩果酸(**6**)、3-oleana-9(11),12-dien-28-oic acid(**7**)、甘五酸(**8**)、altissimanin C(**9**)、7-羟基-β-谷甾醇(**10**)、丁香脂素(**11**)、ficusesquilignan A(**12**)、ficusesquilignan B(**13**)。其中化合物7为新天然产物,化合物1~4、8~13为首次从该属植物中分离得到。

关键词: 黄桐;大戟科;化学成分;结构鉴定
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Chemical Constituents from the Twigs and Leaves of *Endospermum chinense*

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Abstract: To study chemical constituents of *Endospermum chinense*, thirteen known compounds were isolated from the 95% ethanol extract of *E. chinense* with different chromatographic methods. Their structures were identified as pubinernoid A (**1**), (*E*)-linalool-1-oic acid (**2**), (6*S*)-dehydrovomifoliol (**3**), 3α-hydroxy-5,6-epoxy-7-megastigmen-9-one (**4**), oleanolic acid (**5**), 3-ketooleanolic acid (**6**), 3-oleana-9(11),12-dien-28-oic acid (**7**), mangiferonic acid (**8**), altissimanin C (**9**), 7β-hydroxy-β-sitosterol (**10**), syringaresinol (**11**), ficusesquilignan A (**12**), ficusesquilignan B (**13**). Compounds **1-4** and **7-13** were obtained from the genus *Endospermum* for the first time.

Key words: *Endospermum chinense*; Euphorbiaceae; chemical constituents; structural identification

黄桐(*Endospermum chinense* Benth.)为大戟科(Euphorbiaceae)黄桐属乔木。分布于印度东北部、缅甸、泰国、越南以及我国的福建南部、广东、广西、海南和云南南部[1]。据记载[2],黄桐树皮具有治疗伤寒发狂、跌仆伤损等功效,其树叶可用于手足肿浮、痈疽发背等。为了进一步阐明黄桐的化学物质基础,为以后寻找其生理活性以及开发应用提供依据,本课题较为系统地对黄桐枝叶进行了化学成分研究,共分离得到13个化合物,通过波谱数据分析分别鉴定为pubinernoid A(**1**)、(*E*)-linalool-1-oic acid(**2**)、(+)-去氢催吐萝芙木醇(**3**)、3α-hydroxy-5,6-epoxy-7-megastigmen-9-one(**4**)、齐墩果酸(**5**)、3-羰基齐墩果酸(**6**)、3-oleana-9(11),12-dien-28-oic acid(**7**)、甘五酸(**8**)、altissimanin C(**9**)、7-羟基-β-谷甾醇(**10**)、丁香脂素(**11**)、ficusesquilignan A(**12**)、

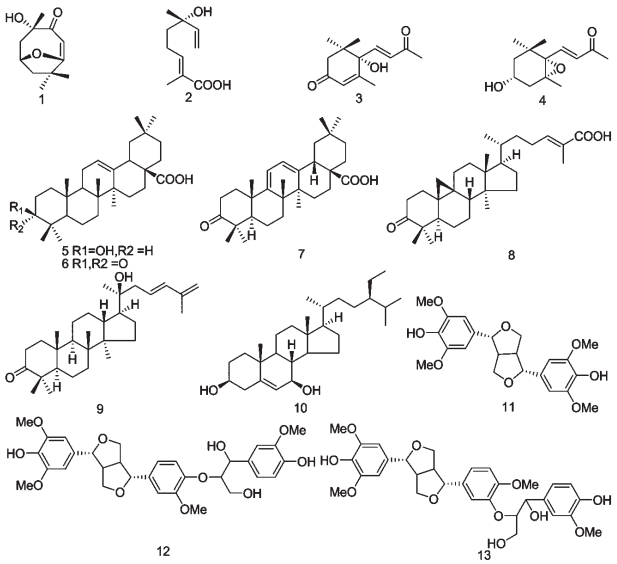

图1 化合物1~13的化学结构

Fig. 1 Chemical structures of compounds **1-13**

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ficusesquilignan B(**13**)。**其中化合物 7 为新天然产物,化合物 1 ~ 4、8 ~ 13 为首次从该属植物中分离得到。**

1 仪器与材料

JASCO P-1020 **全自动数字旋光仪(测比旋度)**; Shimadzu UV-2401 **分光光度仪(测** UV); Bruker Tensor-27 **傅立叶变换中红外光谱仪(测** IR); Bruker AM-400 **和** DRX-500 **核磁共振仪(测定**^{1}H **和**^{13}C NMR **谱),以** TMS **作为内标; 液相-离子阱色谱质谱联用仪** Bruker HCT/Esquire(ESI-MS); **三扇型双聚焦磁质谱仪(**HR-EI-MS **质谱); 高效液相为** Agilent 1100、1200(**美国** Agilent **公司**); Sephadex LH-20(Pharmacia **公司**); **硅胶和薄层色谱硅胶(青岛海洋化工厂); 反相材料** Lichroprep RP-18 gel(**德国** Merck **公司**); MCI gel(**日本三菱化学公司**); 5% H_2SO_4 **乙醇溶液(显色剂)**。

黄桐于 2010 **年** 12 **月采自海南昌江霸王岭,由中科院昆明植物研究所胡光万博士鉴定,标本保存在中科院昆明植物研究所植物化学与西部植物资源持续利用国家重点实验室郝小江研究组(标本号:** No. H20101204)。

2 提取与分离

黄桐干燥枝叶 12 kg,**粉碎后用** 95% **乙醇加热回流提取三次(**4 h/**次),然后用乙酸乙酯** 5 L **萃取三次。乙酸乙酯部分(**300 g) **用硅胶(**100 ~ 200 **目)柱层析(**$V_{石油醚}$∶$V_{丙酮}$ = 9∶1 ~ 5∶5,$V_{氯仿}$∶$V_{甲醇}$ = 9∶1 **和** 7∶3) **分为** 7 **个组分(**A ~ G)。**组分** C、D、E、G **用** MCI **脱色素后,经反相** RP-18、**正相硅胶**、Sephadex LH-20、HPLC **等分离纯化,得到化合物 1(**7 mg)、**2**(7 mg)、**3(**5 mg)、**4(**3 mg)、**5(**10 mg)、**6(**22 mg)、**7**(5 mg)、**8(**11 mg)、**9(**6 mg)、**10(**11 mg)、**11(**8 mg)、**12(**16 mg)、**13(**17 mg)。

3 结构鉴定

化合物 1 **白色粉末,**$C_{11}H_{16}O_3$,^{1}H NMR($CDCl_3$,400 MHz) δ: 1.54 (1H, dd, J = 14.6, 3.7 Hz, H-1α), 1.95 ~ 2.00 (1H, m, H-1β), 2.46 (1H, dt, J = 14.0, 2.4 Hz, H-3β), 5.69 (1H, s, H-6), 1.46, 1.26, 1.78 (each 3H, s, H-9 ~ 11); ^{13}C NMR ($CDCl_3$, 100 MHz) δ: 47.2 (C-1), 66.7 (C-2), 45.5 (C-3), 86.9 (C-4), 182.7 (C-5), 112.8 (C-6), 172.1 (C-7), 35.9 (C-8), 26.4 (C-9), 30.6 (C-10), 26.9 (C-11)。**以上数据与文献**[3] **报道数据基本一致,故鉴定该化合物为** pubinernoid A。

化合物 2 **无色油状,**$C_{10}H_{16}O_3$, $[\alpha]_D^{25}$ +6.4 (c 0.30, $CHCl_3$), ^{1}H NMR ($CDCl_3$, 400 MHz) δ: 6.89 (1H, t, J = 7.2 Hz, H-3), 2.24 (2H, m, H-4), 1.66 (2H, m, H-5), 5.90 (1H, dd, J = 17.3, 10.7 Hz, H-7), 5.09 (1H, d, J = 10.7 Hz, H-8α), 5.23 (1H, d, J = 17.3 Hz, H-8β), 1.82 (3H, s, H-9), 1.31 (3H, s, H-10); ^{13}C NMR ($CDCl_3$, 100 MHz) δ: 173.1 (C-1), 127.1 (C-2), 144.5 (C-3), 23.6 (C-4), 40.4 (C-5), 73.1 (C-6), 144.3 (C-7), 112.3 (C-8), 12.0 (C-9), 27.9 (C-10)。**以上数据与文献**[4] **报道数据基本一致,故鉴定该化合物为(**E)-linalool-1-oicacid。

化合物 3 **黄色油状,**$C_{13}H_{18}O_3$,^{1}H NMR ($CDCl_3$, 400 MHz) δ: 2.50 (1H, d, J = 17.2 Hz, H-2α), 2.36 (1H, d, J = 17.2 Hz, H-2β), 5.96 (1H, s, H-4), 6.83 (1H, d, J = 16.0 Hz, H-7), 6.47 (1H, d, J = 16.0 Hz, H-8), 2.31 (3H, s, H-10), 1.11 (3H, s, H-11), 1.02 (3H, s, H-12), 1.89 (3H, s, H-13); ^{13}C NMR ($CDCl_3$, 100 MHz) δ: 41.4 (C-1), 49.5 (C-2), 197.0 (C-3), 127.7 (C-4), 160.4 (C-5), 79.2 (C-6), 145.0 (C-7), 130.3 (C-8), 197.5 (C-9), 28.4 (C-10), 22.9 (C-11), 24.3 (C-12), 18.7 (C-13)。**以上数据与文献**[5] **报道数据基本一致,故鉴定该化合物为(** +)-**去氢催吐萝芙木醇(**dehydrovomifoliol)。

化合物 4 **黄色油状,**$C_{13}H_{20}O_3$,^{1}H NMR ($CDC1_3$, 400 MHz) δ: 1.64 (1H, m, H-2α), 1.26 (1H, m, H-2β), 1.67 (1H, m, H-4α), 2.40 (1H, dd, J = 14.4, 5.0 Hz, H-4β), 7.02 (1H, d, J = 15.7 Hz, H-7), 6.28 (1H, d, J = 15.7 Hz, H-8), 2.28 (3H, s, H-10), 0.97 (3H, s, H-11), 1.19 (3H, s, H-12), 1.19 (3H, s, H-13); ^{13}C NMR ($CDCl_3$, 100 MHz) δ: 35.1 (C-1), 46.6 (C-2), 63.9 (C-3), 40.5 (C-4), 67.3 (C-5), 69.6 (C-6), 142.5 (C-7), 132.5 (C-8), 197.5 (C-9), 28.3 (C-10), 24.9 (C-11), 29.3 (C-12), 19.8 (C-13)。**以上数据与文献**[6] **报道数据基本一致,故鉴定该化合物为** 3α-hydro-xy-5,6-epoxy-7-megastigmen-9-one。

化合物 5 **白色粉末,**$C_{30}H_{48}O_3$,^{1}H NMR ($CDCl_3$, 500 MHz) δ: 5.28 (1H, br s, H-12), 2.82 (1H, dd, J = 14.0, 4.0 Hz, H-18), 0.90 (3H, s, H-

23),0.91 (3H,s,H-24),0.93 (3H,s,H-25),0.99 (3H,s,H-26),1.13 (3H,s,H-27),0.75 (3H,s,H-29),0.77 (3H,s,H-30);^{13}C NMR ($CDCl_3$,125 MHz) δ:38.5 (C-1),27.7 (C-2),79.0 (C-3),38.7 (C-4),55.3 (C-5),18.3 (C-6),32.7 (C-7),39.6 (C-8),47.7 (C-9),37.0 (C-10),23.0 (C-11),122.7 (C-12),143.6 (C-13),42.0 (C-14),27.2 (C-15),23.4 (C-16),46.5 (C-17),41.1 (C-18),45.9 (C-19),30.7 (C-20),34.0 (C-21),32.5 (C-22),28.1 (C-23),15.5 (C-24),15.3 (C-25),17.1 (C-26),25.9 (C-27),182.4 (C-28),33.0 (C-29),23.6 (C-30)。**以上数据与文献[7]报道数据基本一致,故鉴定该化合物为齐墩果酸**(oleanolic acid)。

化合物6 **白色粉末,**$C_{30}H_{46}O_3$,^{1}H NMR ($CDCl_3$,400 MHz) δ:5.29 (1H,br s,H-12),2.83 (1H,dd,J = 13.3,3.4 Hz,H-18),1.04 (3H,s,H-23),0.79 (3H,s,H-24),0.92 (3H,s,H-25),1.07 (3H,s,H-26),1.13 (3H,s,H-27),0.90 (3H,s,H-29),1.02 (3H,s,H-30);^{13}C NMR ($CDCl_3$,100 MHz) δ:39.2 (C-1),33.9 (C-2),217.9 (C-3),47.4 (C-4),55.2 (C-5),19.6 (C-6),32.2 (C-7),39.0 (C-8),46.8 (C-9),36.7 (C-10),22.9 (C-11),122.3 (C-12),143.1 (C-13),41.7 (C-14),27.6 (C-15),23.7 (C-16),46.5 (C-17),41.0 (C-18),46.0 (C-19),30.6 (C-20),34.1 (C-21),32.2 (C-22),26.4 (C-23),21.4 (C-24),15.0 (C-25),17.0 (C-26),25.8 (C-27),184.2 (C-28),33.0 (C-29),23.5 (C-30)。**以上数据与文献[7]报道数据基本一致,故鉴定该化合物为3-羰基齐墩果酸**(3-ketooleanolic acid)。

化合物7 **白色粉末,**ESI-MS(m/z):475 $[M+Na]^+$,HR-EI-MS(m/z):452.3298 ($C_{30}H_{44}O_3$,calcd for 452.3290);$[\alpha]_D^{14}$ +225.3 (c 0.18,MeOH);IR (KBr) ν_{max} 3443,2945,2867,1705,1632,1463 and 1384 cm^{-1};UV (MeOH) λ_{max}283 nm (0.48),201 nm (0.17);^{1}H NMR ($CDCl_3$,400 MHz) δ:5.58 (1H,d,J = 5.7 Hz,H-12),5.64 (1H,d,J = 5.7 Hz,H-11).0.90,0.94,1.00,1.03,1.06,1.10,1.23 (each 3H,s,7 × CH_3);^{13}C NMR ($CDCl_3$,100 MHz) δ:37.6 (C-1),34.4 (C-2),217.9 (C-3),47.2 (C-4),51.7 (C-5),19.5 (C-6),31.2 (C-7),42.5 (C-8),152.6 (C-9),38.2 (C-10),117.4 (C-11),120.4 (C-12),145.4 (C-13),40.6 (C-14),26.9 (C-15),23.5 (C-16),45.7 (C-17),39.4 (C-18),45.8 (C-19),30.6 (C-20),33.6 (C-21),32.0 (C-22),26.8 (C-23),21.2 (C-24),25.1 (C-25),19.9 (C-26),20.0 (C-27),182.9 (C-28),23.5 (C-29),32.9 (C-30)。**结合文献[7-9]所报道的数据,确定该化合物为3-oleana-9(11),12-diene-28-oic acid,该化合物在文献中为合成的三萜衍生物,并修正了其1D-NMR数据。**

化合物8 **白色粉末,**$C_{30}H_{46}O_3$,^{1}H NMR ($CDCl_3$,400 MHz) δ:0.58 (1H,d,J = 4.0 Hz,H-19α),0.78 (1H,d,J = 4.0 Hz,H-19β),6.90 (1H,t,J = 7.2 Hz,H-24),0.99,1.84,1.04,1.09,0.90 (each 3H,s,H-18,27 ~ 30);^{13}C NMR ($CDCl_3$,100 MHz) δ:33.4 (C-1),37.5 (C-2),216.7 (C-3),50.2 (C-4),48.4 (C-5),21.5 (C-6),25.8 (C-7),47.8 (C-8),21.0 (C-9),25.9 (C-10),26.6 (C-11),32.7 (C-12),45.3 (C-13),48.7 (C-14),35.5 (C-15),28.1 (C-16),52.2 (C-17),18.1 (C-18),29.5 (C-19),35.9 (C-20),18.1 (C-21),25.9 (C-22),34.7 (C-23),145.8 (C-24),126.6 (C-25),173.2 (C-26),11.9 (C-27),22.1 (C-28),20.7 (C-29),19.3 (C-30)。**以上数据与文献[10]报道数据基本一致,故鉴定该化合物为甘五酸**(mangiferonic acid)。

化合物9 **白色粉末,**$C_{30}H_{48}O_2$,^{1}H NMR ($CDCl_3$,400 MHz) δ:5.70 (1H,dt,J = 15.6,7.6 Hz,H-23),6.20 (1H,d,J = 15.6 Hz,H-24),4.90 (2H,brs,H-26),1.00,0.94,1.14,1.85,1.07,1.03,0.88 (each 3H,s,H-18,19,21,27 ~ 30);^{13}C NMR ($CDCl_3$,100 MHz) δ:39.9 (C-1),34.1 (C-2),218.0 (C-3),47.3 (C-4),55.4 (C-5),19.6 (C-6),34.5 (C-7),40.3 (C-8),50.0 (C-9),36.8 (C-10),22.0 (C-11),27.5 (C-12),42.5 (C-13),50.2 (C-14),31.1 (C-15),24.9 (C-16),50.0 (C-17),15.2 (C-18),16.0 (C-19),75.2 (C-20),26.0 (C-2),43.9 (C-22),125.7 (C-23),136.5 (C-24),141.9 (C-25),115.2 (C-26),18.6 (C-27),26.7 (C-28),21.0 (C-29),16.3 (C-30)。**以上数据与文献[11]报道数据基本一致,故鉴定该化合物为** altissimanin C。

化合物10 **白色粉末,**$C_{29}H_{50}O_2$,^{1}H NMR ($CDC1_3$,400 MHz) δ:3.52 (1H,m,H-3),5.28 (1H,m,H-6),3.84 (1H,m,H-7),0.69 (3H,s,H-18),1.04 (3H,s,H-19),0.92 (3H,d,J = 6.4 Hz,H-21),0.82 (3H,m,H-26),0.80 (3H,m,H-28),

0.84 (3H,m,H-29); ^{13}C NMR ($CDCl_3$,100 MHz) δ: 36.9 (C-1), 31.5 (C-2), 71.4 (C-3), 41.7 (C-4), 143.4 (C-5), 125.4 (C-6), 73.3 (C-7), 40.8 (C-8), 48.2 (C-9), 36.4 (C-10), 21.0 (C-11), 39.5 (C-12), 42.8 (C-13), 55.3 (C-14), 26.3 (C-15), 28.5 (C-16), 55.9 (C-17), 11.8 (C-18), 19.1 (C-19), 36.1 (C-20), 18.8 (C-21), 33.9 (C-22), 26.0 (C-23), 45.8 (C-24), 29.1 (C-25), 19.8 (C-26), 19.0 (C-27), 23.0 (C-28), 11.9 (C-29)。**以上数据与文献[12]报道数据基本一致,故鉴定该化合物为** 7-**羟基-β-谷甾醇**(7β-hydroxy-β-sitosterol)。

化合物 11 **黄色粉末,** $C_{22}H_{26}O_8$, ^{1}H NMR ($CDCl_3$,400 MHz) δ: 6.58 (4H,s,H-2,2′,6,6′), 4.75 (2H,d,*J* = 4.3 Hz,H-7,7′), 3.10 (2H,m,H-8,8′), 4.27 (2H,dd,*J* = 12.9,7.8 Hz,Hα-9,9′), 3.80 (2H,dd,*J* = 12.9,7.8 Hz,Hβ-9,9′), 3.90 (12H,s,4 × OCH_3); ^{13}C NMR ($CDCl_3$,100 MHz) δ: 132.0 (C-1,1′), 102.6 (C-2,2′,6,6′), 147.1 (C-3,3′,5,5′), 134.2 (C-4,4′), 86.0 (C-7,7′), 54.3 (C-8,8′), 71.8 (C-9,9′), 56.3 (OCH_3)。**以上数据与文献[13]报道数据基本一致,故鉴定该化合物为丁香脂素**(syringaresinol)。

化合物 12 **无色油状,** $C_{31}H_{36}O_{11}$, ESIMS(*m/z*): 583 $[M-H]^-$, ^{1}H NMR ($CDCl_3$,400 MHz) δ: 6.63 (2H,s,H-2,6), 4.76 (2H,m,H-7,7′), 3.13 (2H,m,H-8,8′), 4.12 (2H,m,Hα-9,9′), 4.30 (2H,m,Hβ-9,9′), 6.73 (1H,dd,*J* = 8.2,1.9 Hz,H-6″), 4.99 (1H,d,*J* = 3.3 Hz,H-7″), 3.88,3.89,3.90 (12H,s,4 × OCH_3); ^{13}C NMR ($CDCl_3$,100 MHz) δ: 131.1 (C-1), 102.7 (C-2,6), 153.4 (C-3,5), 134.2 (C-4), 86.0 (C-7), 54.5 (C-8), 72.1 (C-9), 137.7 (C-1′), 118.7 (C-2′), 146.6 (C-3′), 144.8 (C-4′), 108.3 (C-5′), 114.2 (C-6′), 85.7 (C-7′), 54.0 (C-8′), 71.5 (C-9′), 132.6 (C-1″), 108.6 (C-2″), 146.7 (C-3″), 145.3 (C-4″), 114.3 (C-5″), 118.9 (C-6″), 72.4 (C-7″), 87.0 (C-8″), 60.5 (C-9″), 56.2,55.9 (2 × OCH_3)。**以上数据与文献[14]报道数据基本一致,故鉴定该化合物为** ficusesquilignan A。

化合物 13 **无色油状,** $C_{31}H_{36}O_{11}$, ESIMS(*m/z*): 583 $[M-H]^-$, ^{1}H NMR ($CDCl_3$,400 MHz) δ: 6.62 (2H,s,H-2,6), 4.75 (2H,m,H-7,7′), 3.11 (2H,m,H-8,8′), 3.91 (2H,m,Hα-9,9′), 4.30 (2H,m,Hβ-9,9′), 6.83 (1H,dd,*J* = 8.1,1.8 Hz,H-6″), 5.02 (1H,d,*J* = 9.0 Hz,H-7″), 3.88,3.89,3.90 (12H,s,4 × OCH_3); ^{13}C NMR ($CDCl_3$,100 MHz) δ: 132.6 (C-1), 102.7 (C-2,6), 153.1 (C-3,5), 134.6 (C-4), 85.7 (C-7), 54.0 (C-8), 71.5 (C-9), 137.7 (C-1′), 114.3 (C-2′), 145.3 (C-3′), 146.6 (C-4′), 108.6 (C-5′), 118.9 (C-6′), 85.9 (C-7′), 54.5 (C-8′), 72.1 (C-9′), 131.1 (C-1″), 109.8 (C-2″), 146.7 (C-3″), 145.3 (C-4″), 114.2 (C-5″), 120.3 (C-6″), 74.0 (C-7″), 89.0 (C-8″), 60.5 (C-9″), 56.2,55.9 (2 × OCH_3)。**以上数据与文献[14]报道数据基本一致,故鉴定该化合物为** ficusesquilignan B。

参考文献

1 Flora of China Commission. Flora of China(**中国植物志**). Beijing: Science Press,1996. 183.

2 Li SZ(**李时珍**). Compendium of Materia Medica(**本草纲目**). Guangzhou: World Book Press,1998. 1385.

3 Sheng XH, Jing Y, Wei LX, *et al*. Three novel terpenoids from *Schisandra pubescens* var. *pubinervis*. *Helv Chim Acta*, 2006,89: 1169-1175.

4 Zou K, Tong WY, Liang H, *et al*. Diastereoisomeric saponins from *Albizia julibrissin*. *Carbohyd Res*,2005,340: 1329-1334.

5 Knapp H, Weigand C, Gloser J, *et al*. 2-Hydroxy-2,6,10,10-tetramethyl-1-oxaspiro [4.5] dec-6-en-8-one: precur-sor of 8,9-dehydrotheaspirone in white-fleshed nec - tarines. *J Agric Food Chem*,1997,45: 1309-1313.

6 Yang MC, Lee KH, Kim KH, *et al*. Lignan and terpene constituents from the aerial parts of *Saussurea pulchella*. *Arch Pharm Res*,2007,30: 1067-1074.

7 Feng J(**冯静**), Feng ZY(**冯志毅**), Wang JM(**王君明**), *et al*. Study on the triterpenoids from the fruits of *Ligustrum lucidum*. *J Chin Med Mater*(**中药材**),2011,34: 1540-1544.

8 Bioactive 12-oleanene triterpene and secotriterpene acids from May-tenusundata. *J Nat Prod*,2000,63: 605-610.

9 Lei HM(**雷海明**), Ren J(**任健**), Wang PL(**王鹏龙**), *et al*. Synthesis of oleanolic acid derivatives and application for treating hepatitis B. Faming Zhuanli Shenqing, 2012, CN 102675403 A.

10 Zhang HJ, Tan GT, Hoang VD, *et al*. Natural anti-HIV agents. part IV. anti-HIV constituents from *Vatica cinerea*. *J Nat Prod*,2003,66: 263-268.

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醇。^{1}H NMR (500 MHz, $CDCl_3$) δ 6.96 (1H, d, J = 8.2 Hz, H-5), 6.80 (1H, d, J = 8.7 Hz, H-6′), 6.47 (1H, d, J = 8.7 Hz, H-5′), 6.40 (1H, dd, J = 11.8, 2.4 Hz, H-6), 6.38 (1H, d, J = 2.4 Hz, H-8), 4.35 (1H, d, J = 1.5 Hz, H-2), 4.07 (1H, t, J = 10.0 Hz, H-2), 3.95 (3H, s, OCH_3), 3.87 (3H, s, OCH_3), 3.55 (1H, m, H-3), 3.03 (1H, dd, J = 16.1, 10.3 Hz, H-4), 3.01 (1H, ddd, J = 16.1, 12.1, 1.7 Hz, H-4); ^{13}C NMR (126 MHz, $CDCl_3$) δ 155.2 (C-7), 154.9 (C-9), 151.1 (C-4′), 147.5 (C-3′), 135.4 (C-2′), 130.4 (C-5), 121.8 (C-6′), 120.3 (C-1′), 114.8 (C-10), 107.9 (C-6), 103.7 (C-5′), 103.2 (C-8), 69.7 (C-2), 61.0 (OCH_3), 55.8 (OCH_3), 32.1 (C-3), 30.2 (C-4)。**其数据与文献[17]基本一致,故鉴定为** 3′,7-**二羟基-**2′,4′-**二甲氧基异黄烷。**

参考文献

1 Luobusang (**罗布桑**). Mongolian pharmacy (**蒙药学**). Huhhot: Inner-Mongol people publishing house, 2006. 196.

2 Zhao WD continuing study course of Mongolian medicine (**昭乌达盟蒙药进修班**). Mongol Em Nairalgin Emhidgel (**蒙医药方汇编**). Shenyang: Liaoning People's Publishing House, 1977. 62-64.

3 Lu JH, Liu Y, Zhao YY, *et al*. New flavonoids from *Oxytropis myriophylla*. *Chem Pharm Bull*, 2004, 52: 276-278.

4 She GM, Sun FF, Liu B. Three new flavonoid glycosides from *Oxytropis myriophylla*. *J Nat Med*, 2012, 66: 208-212.

5 She GM, Wang S, Liu B. Dihydrochalcone glycosides from *Oxytropis myriophylla*. *Chem Cent J*, 2011, 5: 71-73.

6 She GM, Sun FF, Liu Bin. A new lignan from *Oxytropis myriophylla*. *Nat Prod Res*, 2012, 26: 1285-1290.

7 Okawa M, Yamaguchi R, Delger H, *et al*. Five triterpene glycosides from *Oxytropis myriophylla*. *Chem Pharm Bull*, 2002, 50: 1097-1099.

8 Kojima K, Purevsuren S, Narantuya S, *et al*. Alkaloids from *Oxytropis myriophylla* (Pall.) DC. *Sci Pharm*, 2001, 69: 383-388.

9 Jiao J (**焦姣**), Sun H (**孙慧**), Lan J (**兰杰**), *et al*. The fungicidal constituents′ extraction, isolation and determination on *Amorpha fruticosa* L. *Agrochemicals*, 2012, 51: 491-493.

10 Achenbach H, Stoecher M, Constenla MA. Constituents of tropical medicinal plants. Part31. Flavonoid and other constituents of *Bauhinia manca*. *Phytochemistry*, 1988, 27: 1835.

11 Eun-Ryeong H, Seyeon P, Chul-Hak Y. 7, 8-dihydroxyflavanone as an inhibitor for Jun-Fos-DNA complex formation and its cytotoxic effect on cultured human cancer cells. *Nat Produ Res*, 2003, 17: 431-436.

12 Wang CF (**王彩芳**), Li JP (**李俊平**), Li RR (**李娆娆**), *et al*. Structural elucidation of three flavonoids extracted from the Rhizomes of *Ligularia vellereaby* NMR spectroscopy. *Chin J Magn Res* (**波谱学杂志**), 2009, 2: 264-271.

13 Lv F (**吕芳**), Xu XJ (**徐筱杰**). Studies on flavonoids of *Oxytropis falcata*. *Chin J Chin Mater Med* (**中国中药杂志**), 2007, 4: 318-320.

14 Xie X (**谢雪**), Zhang HD (**张宏达**), Chen YZ (**陈昱竹**), *et al*. Chemical constituents and activities of total flavonoids from Yushen Tang. *Chin J Chin Mater Med* (**中国中药杂志**), 2012, 37: 3585-3590.

15 Gao W (**高雯**), Shen Y (**沈阳**), Zhang HJ (**张红军**), *et al*. The chemical constituents of *Potentilla chinensis*. *Pharm Care Res* (**药学服务与研究**), 2007, 7: 262-264.

16 Fathiazad F, Mazandarani M, Hamedeyazdan S, *et al*. Phytochemical analysis and antioxidant activity of *Hyssopus officinalis* L. from Iran. *Adv Pharm Bull*, 2011, 1 (2): 63-67.

17 Li ZJ (**李志军**). Studies on the chemical of *Oxytropis myriophylla* (Pall.) DC. Zhengzhou: Henan University, MSc. 2010.

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11 Hong ZL, Xiong J, Wu SB, *et al*. Tetracyclic triterpenoids and terpenylated coumarins from the bark of *Ailanthus altissima*. *Phytochemistry*, 2013, 86: 159-167.

12 Gong HF (**巩红飞**), Yang AM (**杨爱梅**), Liu JX (**柳君玺**), *et al*. Studies on chemical constituents of *Oxytropis kansuensis*. *Chin Trad Herb Drugs* (**中草药**), 2010, 41: 187-190.

13 Zhu JX, Ren J, Qin JJ, *et al*. Phenylpropanoids and lignanoids from *Euonymus acanthocarpus*. *Arch Pharm Res*, 2012, 35: 1739-1747.

14 Li YC, Kuo YH. Four new compounds, ficusal, ficusesquilignan A, B, and ficusolide diacetate from the heart-wood of *Ficus microcarpa*. *Chem Pharm Bull*, 2000, 48: 1862-1865.