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夏枯草茎叶化学成分研究

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摘　要:研究夏枯草 *Prunella vulgaris* 茎叶中的化学成分。采用硅胶和凝胶柱色谱进行分离,根据化合物理化性质和光谱数据鉴定其结构。分离得到9个化合物,分别为:对羟基苯甲酸(**1**)、原儿茶酸(**2**)、尿黑酸(**3**)、咖啡酸(**4**)、金丝桃苷(**5**)、异槲皮苷(**6**)、山柰酚(**7**)、槲皮素(**8**)、槲皮苷(**9**)。结论:化合物 **1**~**3**,**7**,**9** 为首次从该植物中分离得到。

关键词:夏枯草;化学成分;黄酮

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Chemical Constituents in Herbs of *Prunella vulgaris*

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Abstract: To study the chemical constituents in herb of *Prunella vulgaris*. Compounds were isolated with silica gel and Sephadex LH-20 chromatography and their structures were determined by spectral analysis and chemical evidence. Nine compounds were obtained and identified as *p*-hydroxybenzoic acid (**1**), protocatechuic acid (**2**), gentisic acid (**3**), caffeic acid (**4**), hyperoside (**5**), isoquercitrin (**6**), kaempferol (**7**), quercetin (**8**), quercitrin (**9**). Compounds **1**~**3**, **7**, **9** were isolated from *Prunella vulgaris* for the first time.

Key words: *Prunella vulgaris*; chemical constituents; flavonoids

夏枯草 *Prunella vulgaris* L. 为唇形科夏枯草属植物,其果穗作为常用中药夏枯草收载于历版《中国药典》,具有清火明目、散结消肿之功效,用于治疗目赤肿痛、头痛眩晕、高血压等症[1]。据考证[2]夏枯草入药部位古代用茎叶,现代用果穗。国内外对夏枯草果穗有许多研究报道,其主要含有三萜、黄酮、甾醇和香豆素类化合物,但夏枯草茎叶的研究报道较少。本研究报道从夏枯草茎叶中分离得到的9个化合物,分别为:对羟基苯甲酸(**1**)、原儿茶酸(**2**)、尿黑酸(**3**)、咖啡酸(**4**)、金丝桃苷(**5**)、异槲皮苷(**6**)、山柰酚(**7**)、槲皮素(**8**)、槲皮苷(**9**)。其中,化合物 **1**~**3**、**7**、**9** 为首次从该植物中分离得到。

1　仪器与材料

Bruker AM 500 型核磁共振仪,TMS 为内标物;Finnigan-LCQ^{DECA} 型质谱仪;Buchi Melting Point B-540 显微熔点测定仪(未校正);柱色谱用硅胶(200~300 目,300~400 目)为青岛海洋化工厂生产;Sephadex LH-20 为 Pharmacia 公司产品;其余试剂均为分析纯。夏枯草茎叶于 2009 年 5 月采自安徽芜湖,原植物经严启新博士鉴定为夏枯草 *Prunella vulgaris* L.。

2　提取与分离

夏枯草茎叶 5 kg,80% 乙醇回流提取 2 次,提取液合并,减压回收至无醇味,加水至 2 L,混悬均匀,依次加等量石油醚、乙酸乙酯、正丁醇萃取三次。乙酸乙酯萃取液减压回收得浸膏 200 g 经硅胶柱色谱分离,二氯甲烷-甲醇(100∶0~0∶100)梯度洗脱,共收集 95 个流分。Fr.9~11 经硅胶柱色谱石油醚-乙酸乙酯(10∶1)洗脱,再经 Sephadex LH-20(二氯甲烷-甲醇)纯化,得化合物 **1**(20 mg)、**2**(35 mg);Fr.15~18 经硅胶柱色谱石油醚-乙酸乙酯(10∶1)洗脱,再经 Sephadex LH-20(二氯甲烷-甲醇)纯化,得化合物 **3**(13 mg);Fr.26~29 经硅胶柱色谱石油醚-乙酸乙酯(3∶1)洗脱,再经 Sephadex LH-20(甲醇)纯化,得化合物 **4**(25 mg)、**7**(20 mg)、**8**(30 mg);

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Fr. 51 ~ 56 经硅胶柱色谱乙酸乙酯-甲醇-水(8∶2∶0.5)洗脱,再经 Sephadex LH -20 甲醇-水(80∶20)纯化,得化合物 **5**(40 mg)、**6**(20 mg)、**9**(15 mg)。

3　结构鉴定

化合物 1　白色针晶(乙酸乙酯),mp. 214 ~ 216 ℃。ESI-MS (m/z):139 $[M+H]^+$。^{1}H NMR (DMSO-d_6,500 MHz) δ:12.1 (1H,s,COOH),9.3 (1H,s,OH),7.07 (2H,d,J = 8.4 Hz,H-2,6),6.71 (2H,d,J = 8.5 Hz,H-3,5);^{13}C NMR (DMSO-d_6,125 MHz) δ:173.05 (C-7),155.9 (C-4),130.2 (C-2,6),125.08 (C-1),114.9 (C-3,5)。以上数据与文献[3]对照基本一致,鉴定该化合物为对羟基苯甲酸(*p*-hydroxy benzoic acid)。

化合物 2　黄色针晶(乙酸乙脂),mp. 192 ~ 193 ℃。ESI-MS (m/z):155 $[M+H]^+$。^{1}H NMR (CD_3OD,500 MHz) δ:7.44 (1H,d,J = 2.0 Hz,H-2),7.43 (1H,dd,J = 2.0,8.0 Hz,H-6),6.80 (1H,d,J = 8.0 Hz,H-5)。以上数据与文献[4]对照基本一致,鉴定该化合物为原儿茶酸(protocatechuic acid)。

化合物 3　黄色针晶(乙酸乙脂),mp. 202 ~ 203 ℃。ESI-MS (m/z):155 $[M+H]^+$。^{1}H NMR (CD_3OD,500 MHz) (:7.24 (1H,d,J = 3.0 Hz,H-6),6.94 (1H,dd,J = 9.0,3.0 Hz,H-4),6.76 (1H,d,J = 9.0 Hz,H-3);^{13}C NMR (CD_3OD,125 MHz) (:171.9 (C-7),155.0 (C-2),149.1 (C-5),123.2 (C-4),117.3 (C-6),114.6 (C-3),112.4 (C-1)。以上数据与文献[5]对照基本一致,鉴定该化合物为尿黑酸(gentisic acid)。

化合物 4　黄色粉末(乙酸乙酯),mp. 206 ~ 207 ℃。ESI-MS (m/z):181 $[M+H]^+$。^{1}H NMR (CD_3OD,500 MHz) δ:7.53 (1H,d,J = 15.9 Hz,H-7),7.02 (1H,d,J = 2.0 Hz,H-2),6.93 (1H,dd,J = 8.1,2.0 Hz,H-6),6.77 (1H,d,J = 8.1 Hz,H-5),6.22 (1H,d,J = 15.9 Hz,H-8)。以上数据与文献[6]对照基本一致,鉴定该化合物为咖啡酸(caffeic acid)。

化合物 5　黄色粉末(甲醇),mp. 235 ~ 237 ℃。ESI-MS (m/z):465 $[M+H]^+$。^{1}H NMR (CD_3OD,500 MHz) δ:7.70 (1H,d,J = 2.0 Hz,H-2′),7.56 (1H,dd,J = 2.0,8.4Hz,H-6′),6.84 (1H,d,J = 8.4 Hz,H-5′),6.33 (1H,d,J = 2.0 Hz,H-8),6.17 (1H,d,J = 2.0 Hz,H-6),5.15 (1H,d,J = 7.8 Hz,H-1″);^{13}C NMR (CD_3OD,125 MHz) δ:180.2 (C-4),166.4 (C-7),163.4 (C-5),159.5 (C-2),158.8 (C-9),150.2 (C-4′),146.3 (C-3′),135.9 (C-3),123.3 (C-6′),121.3 (C-1′),118.4 (C-2′),116.6 (C-5′),106.1 (C-1″),105.9 (C-10),100.4 (C-6),95.3 (C-8),77.6 (C-5″),75.5 (C-3″),73.5 (C-2″),70.6 (C-4″),62.4 (C-6″)。以上数据与文献[7]对照基本一致,鉴定该化合物为金丝桃苷(hyperoside)。

化合物 6　黄色粉末(甲醇),mp. 230 ~ 232 ℃。ESI-MS (m/z):465 $[M+H]^+$。^{1}H NMR (CD_3OD,500 MHz) δ:7.70 (1H,d,J = 2.0 Hz,H-2′),7.56 (1H,dd,J = 2.0,8.4 Hz,H-6′),6.86 (1H,d,J = 8.4 Hz,H-5′),6.31 (1H,d,J = 1.8 Hz,H-8),6.18 (1H,d,J = 1.8 Hz,H-6),5.24 (1H,d,J = 7.4 Hz,H-1″);^{13}C NMR (CD_3OD,125 MHz) δ:179.5 (C-4),166.0 (C-7),163.1 (C-5),158.3 (C-9),159.1 (C-2),150.0 (C-4′),146.1 (C-3′),135.6 (C-3),123.4 (C-1′),123.1 (C-6′),116.1 (C-5′),117.6 (C-2′),104.5 (C-10),　105.7 (C-1″),100.1 (C-6),94.7 (C-8),78.4 (C-5″),78.3 (C-3″),75.8 (C-2″),71.3 (C-4″),62.7 (C-6″)。以上数据与文献[8]对照基本一致,鉴定该化合物为异槲皮苷(isoquercitrin)。

化合物 7　黄色针晶(甲醇),mp. 281 ~ 283 ℃。ESI-MS (m/z):287 $[M+H]^+$。^{1}H NMR (DMSO-d_6,500 MHz) δ:12.47 (1H,s,5-OH),10.77 (1H,s,7-OH),10.09 (1H,s,3-OH),9.36 (1H,s,4′-OH),8.03 (2H,dd,J = 2.0,7.8Hz,H-2′,6′),6.90 (2H,dd,J = 2.0,7.8Hz,H-3′,5′),6.43 (1H,d,J = 1.6Hz,H-8),6.18 (1H,d,J = 1.6Hz,H-6)。以上数据与文献[9]对照基本一致,鉴定该化合物为山奈酚(kaempferol)。

化合物 8　黄色针晶(甲醇),mp. 314 ~ 316 ℃。ESI-MS (m/z):303 $[M+H]^+$。^{1}H NMR (DMSO-d_6,500 MHz) δ:12.48 (1H,s,5-OH),10.75 (1H,s,7-OH),9.55 (1H,s,4′-OH),9.32 (1H,s,3′-OH),9.27 (1H,s,3-OH),7.67 (1H,d,J = 2.2Hz,H-2′),7.53 (1H,dd,J = 2.2,8.5 Hz,H-6′),6.89 (1H,d,J = 8.5 Hz,H-5′),6.40 (1H,d,J = 2.0 Hz,H-8),6.18 (1H,d,J = 2.0 Hz,H-6)。以上数据与文献[10]对照基本一致,鉴定该化合物为槲皮素(quercetin)。

化合物 9 黄色粉末(甲醇),mp. 179 ~ 181 ℃。ESI-MS (*m/z*):449 [M + H]$^+$。^{1}H NMR (DMSO-d_6, 500 MHz) δ:12.68 (1H, s, 5-OH), 10.85 (1H, s, 7-OH), 9.68 (1H, s, 4′-OH), 9.32 (1H, s, 3′-OH), 7.32 (1H, d, *J* = 2.1 Hz, H-2′), 7.28 (1H, dd, *J* = 2.1, 8.5 Hz, H-6′), 6.89 (1H, d, *J* = 8.5 Hz, H-5′), 6.41 (1H, d, *J* = 2.0 Hz, H-8), 6.23 (1H, d, *J* = 2.0 Hz, H-6), 5.27 (1H, d, *J* = 1.6 Hz, H-1″), 0.83 (3H, d, *J* = 6.2 Hz, H-6″); ^{13}H NMR (DMSO-d_6, 125 MHz) δ:177.6 (C-4), 164.0 (C-7), 161.1 (C-5), 157.7 (C-9), 156.2 (C-2), 148.1 (C-4′), 144.9 (C-3′), 134.0 (C-3), 120.7 (C-6′), 120.5 (C-1′), 115.4 (C-2′), 115.2 (C-5′), 103.8 (C-10), 101.0 (C-1″), 98.4 (C-6), 93.3 (C-8), 71.0 (C-4″), 70.3 (C-3″), 70.1 (C-2″), 69.5 (C-5″), 17.2 (C-6″)。以上数据与文献[11]对照基本一致,鉴定该化合物为槲皮苷(quercitrin)。

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