FLAVONOIDS FROM THE AERIAL PART OF *Hypericum perforatum*

V. A. Kurkin and O. E. Pravdivtseva

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St. John's-wort (*Hypericum perforatum* L., Hypericaceae) is widely used in medical practice in the RF as an anti-inflammatory and astringent [1, 2]. Until now it was unknown namely what biologically active compounds of St. John's-wort produce neutropic effects although antidepressants based on it are produced. It is known that the herb contains flavonoids (rutin, hyperoside), anthracene derivatives (hypericin, pseudohypericin), phloroglucinols (hyperforin), tanning agents, essential oil, etc. [3, 4].

The goal of our work was to investigate the chemical composition of St. John's-wort.

The aerial part of the herb was collected during flowering in July 2006 in Samara Oblast′ and extracted using 90 and 70% ethanol. Subsequent chromatography of the extracts over a column of silica gel (L 40/100) with elution by $CHCl_3$, C_2H_5OH:$CHCl_3$ mixtures of various proportions, and C_2H_5OH isolated successively several fractions of compounds with predominantly the target components. Rechromatography over columns of polyamide isolated pure compounds **1**-**5**. Separation of the compounds was monitored by TLC on Silufol UV 254 and Sorbfil PTLC-P-A-UV plates using $CHCl_3$:C_2H_5OH (2:1) and $CHCl_3$:C_2H_5OH:H_2O (26:16:3). Isolated compounds were identified using PMR spectroscopy, mass spectrometry, UV spectroscopy, various chemical transformations, and TLC.

Compounds **1**-**5** are flavonoids and were identified as 3,8″-bisapigenin, quercetin, 6,8″-diquercetin, hyperoside, and rutin. Comparison of the TLC behavior of the isolated components showed that the R_f value of bisapigenin was similar to that of quercetin. The $CHCl_3$:C_2H_5OH:H_2O (26:16:3) system used by us enabled spots of compounds corresponding to quercetin and bisapigenin to be clearly separated, which was not observed for other solvent systems that have been described previously. Furthermore, we consider TLC to be suitable for qualitative analysis of raw material and St. John's-wort preparations.

3,8″-Bisapigenin (1), $C_{30}H_{18}O_{10}$, 538 (100%) $[M]^+$. UV spectrum (EtOH, λ_{max}, nm): 270, 330. PMR spectrum (200 MHz, $(CD_3)_2CO + D_2O$, δ, ppm, J/Hz): 6.34 (1H, s, H-6″), 6.35 (1H, d, J = 2.5, H-6), 6.60 (1H, d, J = 2.5, H-8), 6.61 (1H, s, H-3″), 7.79 (2H, d, J = 9.0, H-3‴,5‴), 6.90 (2H, d, J = 9.0, H-3′,5′), 7.51 (2H, d, J = 9.0, H-2‴,6‴), 7.71 (2H, d, J = 9.0, H-2′,6′), 12.99 (1H, s, 5″-OH), 13.15 (1H, s, 5-OH).

Quercetin (2), $C_{15}H_{10}O_7$, mp 301-304°C, 302 (100%) $[M]^+$. UV spectrum (EtOH, λ_{max}, nm): 257, 268sh, 372. PMR spectrum (200 MHz, $(CD_3)_2CO$, δ, ppm, J/Hz): 6.26 (1H, d, J = 2.5, H-6), 6.53 (1H, d, J = 2.5, H-8), 6.99 (1H, d, J = 9.0, H-5′), 7.70 (1H, dd, J = 2.0, 9.0, H-6′), 7.83 (1H, d, J = 9.0, H-2′), 12.20 (1H, s, 5-OH).

6,8″-Diquercetin (3), $C_{30}H_{18}O_{14}$. UV spectrum (EtOH, λ_{max}, nm): 257, 268sh, 374. PMR spectrum (200 MHz, $(CD_3)_2CO$, δ, ppm, J/Hz): 6.27 (1H, br.s, H-6), 6.53 (1H, br.s, H-8), 6.89 (1H, d, J = 9.0, H-5‴), 6.98 (d, J = 9.0, H-5′), 7.48 (1H, dd, J = 2.0, 9.0, H-6‴), 7.53 (1H, d, J = 9.0, H-2‴), 7.70 (1H, dd, J = 2.0, 9.0, H-6′), 7.83 (1H, d, J = 9.0, H-2′).

Hyperoside (4), $C_{21}H_{20}O_{12}$, mp 233-235°C (aqueous acetone). UV spectrum (EtOH, λ_{max}, nm): 258, 266sh, 362. PMR spectrum (200 MHz, $(CD_3)_2CO + D_2O$, δ, ppm, J/Hz): 3.5-4.0 (6H of galactose), 5.20 (1H, d, J = 9.0, H-1″ of galactose), 6.21 (1H, d, J = 2.5, H-6), 6.45 (1H, d, J = 2.5, H-8), 6.88 (1H, d, J = 9.0, H-5′), 7.55 (1H, dd, J = 2.5, 9.0, H-6′), 7.92 (1H, d, J = 2.5, H-2′), 12.30 (1H, s, 5-OH).

Rutin (5), $C_{27}H_{30}O_{16}$, mp 192-194°C (aqueous alcohol). UV spectrum (EtOH, λ_{max}, nm): 258, 266sh, 362. PMR spectrum (200 MHz, $(CD_3)_2CO + D_2O$, δ, ppm, J/Hz): 1.08 (3H, d, J = 6.0, CH_3 of rhamnose), 3.70-3.25 (10H of the sugar), 4.55 (1H, d, J = 2.0, H-1‴ of rhamnose), 5.13 (1H, d, J = 7.0, H-1″ of glucose), 6.27 (1H, d, J = 2.5, H-6), 6.50 (1H, d, J = 2.5, H-8), 6.94 (1H, d, J = 9.0, H-5′), 7.68 (1H, dd, J = 2.5, 9.0, H-6′), 7.74 (1H, d, J = 9.0, H-2′).

3,8″-Bisapigenin (**1**) was isolated for the first time from St. John's-wort growing in the RF. Compound **3**, which we isolated as a minor component and preliminarily identified as 6,8″-diquercetin, was first described from the genus *Hypericum*.

GOU VPO Samara State Medical University of Roszdrav, 443099, Samara, ul. Chapaevskaya, 89, fax 8(846) 333 29 76, e-mail: vakur@samaramail.ru. Translated from Khimiya Prirodnykh Soedinenii, No. 5, pp. 512-513, September-October, 2007. Original article submitted July 2, 2007.

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In our opinion, it is interesting that the flavonoid hyperoside showed neurotropic activity, which has not previously been reported. Furthermore, other components isolated by us are now in preclinical trials in animals in order to determine their neurotropic activity. The new data on the chemical composition of St. John's-wort enabled us to develop new approaches to standardizing the raw material and preparations and to improve the method for preparing tincture of St. John's-wort, which has antidepressant activity.

REFERENCES

1. *State Registry of Drugs* [in Russian], Vol. 1, Official Edition, Moscow (2004).
2. *State Pharmacopeia of the USSR* [in Russian], 11th Edition, No. 2, Meditsina, Moscow (1990).
3. G. M. Kitanov and K. F. Blinova, *Khim. Prir. Soedin.*, 185 (1987).
4. V. A. Kurkin, *Pharmacognosy* [in Russian], OOO Ofort, GOU VPO SamGMU, Samara (2004).
5. *Plant Resources of the USSR: Flowering Plants, Their Chemical Composition and Use: Paeoniaceae-Thymelaeaceae Families* [in Russian], Nauka, Leningrad (1985), pp. 16-18.