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PHLOMOSIDE C — AN IRIDOID GLYCOSIDE FROM *Phlomis regelii*

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A new iridoid — phlomoside C — has been isolated from the epigeal part of Phlomis regelii *M. Pop. Its structure has been established on the basis of spectral characteristics and chemical transformations.*

We have previously [1] reported the structure of phlomoside D, isolated from the plant *Phlomis regelii* M. Pop., fam. Lamiaceae. In the present paper we consider a proof of the structure of phlomoside C (**1**).

The IR spectrum of (**1**) showed a broad absorption band at (cm^{-1}) 3427 (OH group), a maximum at 1633 characteristic for a double bond at C-3−C-4, and also a broad band at 1721-1725 and bands at 1279, 1236 (ester) and at 1602, 1452, 716 (benzene ring). The presence of an aromatic ring was also shown by the signals of five aromatic protons in the PMR spectrum of compound (**1**) at (ppm) 7.3-7.8 (3H) and 8.08 (2H). The signal of the methyl of an acetyl group was observed in the PMR spectrum at 1.90 ppm.

After alkaline hydrolysis of the iridoid, lamiide (**2**) [2] was identified in the neutral fraction. The acid hydrolysis of (**1**) led to the isolation of *D*-glucose and to a black decomposition product of the aglycon moiety of the iridoid.

It follows from a comparison of the characteristics of the PMR spectra of (**1**) and (**2**) (Table 1) that in the case of phlomoside C the H-7 and CH_3-10 resonance lines have undergone paramagnetic displacements of 1.9 and 0.43 ppm, which are greater than the local effect of acylation on the chemical shifts of the protons under consideration. This factor is a consequence of the total descreening influence arising on the simultaneous acylation of the hydroxy groups at C-7 and C-8.

TABLE 1. Chemical Shifts (ppm), Multiplicities, and SSCCs (J, Hz) of the Signals in the PMR Spectrum of Phlomoside C (**1**), Lamiide (**2**), and Phlomoside D (**3**) in CD_3OD and of Its Pentaacetyl Derivative (**4**) in $CDCl_3$ Relative to TMS

Protons	Compound			
	1	2	3	4
H-1	6.14, d, J=0.7 Hz,	5.81, s	5.85, s	5.96, s
H-3	7.52, s	7.42, s	7.46, s	7.38, s
H-6	2.61, d.d, J=15.0 and 4.5 Hz	2.37, d.d, J~15.5, 5 Hz	2.49 br.d	2.53 br.d
H-6	2.51, d.d, J=15.0 and 1.5 Hz	2.22, d.d, J~15.5, 4.5 Hz	2.49 br.d	2.53 br.d
H-7	5.42, d.d, J=4.5 and 2.0 Hz	3.52, d.d, J~5, 3.4 Hz	5.02, t ΣJ~6.5 Hz	5.38, t, ΣJ=8.0 Hz
H-9	3.25, br.s	2.78, br.s	3.01, br.s	3.37, br.s
CH_3-10	1.51, s	1.08, s	1.22, s	1.52, s
$COOCH_3$	3.76, s	3.72, s	3.75, s	3.78, s
H-1′	4.69, d, J~7.5 Hz	4.59, d J~7.9 Hz	4.64, d J~7.5 Hz	5.06, d 1~8.0 Hz
Ar	7.3–7.77 m (3H), 8.08, d.d, J=8.0 and 2.0 Hz, (2H)	–	7.54(3H), 8.14(2H)	7.50(3H) 7.99(2H)
$OCOCH_3$	1.90, s	–	–	1.96(6H), 2.02, 2.05, 2.09

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TABLE 2. Chemical Shifts (ppm) of the ^{13}C Carbon Atoms of Phlomoside C (**1**) and of Lamiide (**2**) in CD_3OD

Carbon atom	Compound		Carbon atom	Compound	
	1	2		1	2
1	94.22	94.42	4′	71.75	71.56
3	152.82	152.45	5′	78.57	78.28
4	115.60	115.33	6′	63.06	62.67
5	67.89	69.17	1″	131.85	–
6	45.98	46.68	2″	130.93	–
7	78.70	77.83	3″	129.98	–
8	86.54	79.10	4″	134.77	–
9	58.82	57.89	5″	129.98	–
10	18.08	21.21	6″	130.93	–
11	167.89	167.99	OCH_3	52.08	51.69
1′	100.30	99.49	OCOAr	166.69	–
2′	74.71	74.32	OCOMe	171.90	–
3′	77.72	77.31	OCOMe	21.20	–

The mild alkaline hydrolysis of phlomoside C with a 0.5% solution of $KHCO_3$ at room temperature gave the deacetyl product (**3**), coinciding in its physicochemical constants and spectral characteristics with phlomoside D (**3**) (see Table 1) [1]. Consequently a benzoic acid residue is present in the cyclopentane nucleus and is bound to the oxygen atom at C-7.

As can be seen from Table 1, on passing from lamiide to phlomoside D the difference in the chemical shift of CH_3-10 is 0.14 ppm, while for phlomoside C this magnitude is 0.29 ppm. In sum they amount to the 0.43 ppm mentioned above. The same thing is observed in the NMR spectrum of phlomoside D pentaacetate (**4**), allowing for the influence of the medium — in this case $CDCl_3$.

In the PMR spectrum of (**1**), the signal of the H-1′ proton appears at 4.69 ppm in the form of a doublet with J = 4.5 Hz, which shows the β-configuration of the anomeric center.

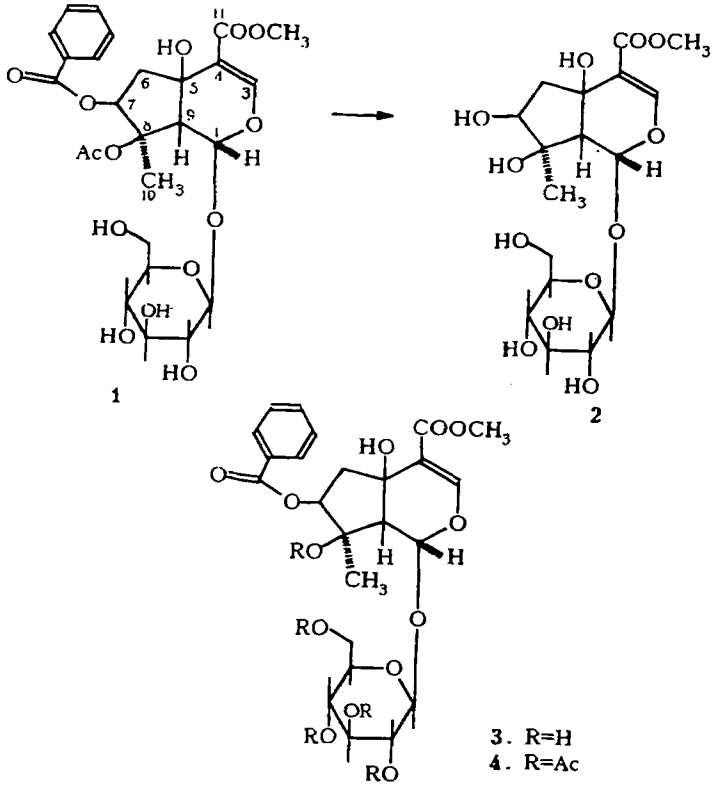

Table 2 gives the chemical shifts of the carbon atoms of lamiide [2-4] and of phlomoside C. Taken together, all the facts given above unambiguously show that phlomoside C (**1**) is 7-O-benzoyl-8-O-acetyllamiide.

EXPERIMENTAL

The PMR spectra of compounds (**2**)–(**4**) and the ^{13}C NMR spectrum of (**2**) were taken on a BS-567 A spectrometer, and the corresponding spectra of (**1**) on a WM-500 (500 MHz, Bruker). For other information, see [1].

Phlomoside C. Elution with the chloroform–methanol (100:1) system led to the isolation of 90 mg of iridoid (**1**) (yield 0.015%, calculated on the air-dry raw material), $C_{26}H_{32}O_{14}$, amorphous, $[\alpha]_D^{22}$ 0 ± 2° (*c* 0.57; methanol).

Alkaline Hydrolysis of Phlomoside C (1). A. A solution of 30 mg of iridoid (**1**) in 10 ml of methanol was treated with 60 mg of potassium bicarbonate in 8 ml of water. The reaction mixture was left at room temperature for three days, and it was then diluted with water (50 ml), neutralized, and extracted with ethyl acetate.

The solvent was distilled off to dryness, and the residue was chromatographed on a column of silica gel. Elution of the column with the chloroform–methanol (50:1) system yielded 23 mg of lamiide (**2**), identical with an authentic specimen according to TLC and to IR and PMR spectra [1, 2].

B. A solution of 20 mg of iridoid (**1**) in 6 ml of 0.5% $KHCO_3$ was kept at room temperature for 6 h. Then the mixture was neutralized and extracted with ethyl acetate. The solvent was distilled off to dryness, and the residue was chromatographed on a column of silica gel. Elution with the chloroform–methanol (100:1) system gave 12 mg of phlomoside D (**3**), identical with an authentic specimen according to TLC and PMR [1].

Acid Hydrolysis. The iridoid (1) (8 mg) was hydrolyzed in 5 ml of 5% sulfuric acid at 100°C for 3 h, and the resulting precipitate was separated off. In the hydrolysate, after neutralization with barium carbonate and concentration in vacuum, glucose was detected by paper chromatography in the butanol–pyridine–water (6:4:3) system.

REFERENCES

1. M. S. Maksudov, E. S. Maksimov, Z. Saatov, and N. D. Abdullaev, Khim. Prir. Soedin., 551 (1996) [preceding paper in this issue].
2. M. L. Scarpati and M. Guiso, Gazz. Chim. Ital., **99**, 1150 (1969).
3. M. S. Maksudov, E. S. Maksimov, R. U. Umarov, Z. Saatov, and N. D. Abdullaev, Khim. Prir. Soedin., 243 (1995).
4. V. A. Mnakatsanyan, Iridoid Glycosides [in Russian], Izd. Akad. Nauk ArmSSR, Erevan (1986), p. 186.