

Synthesis of 5-(5-arylsulfo-2-furyl)-1-tetrazolylacetic acids

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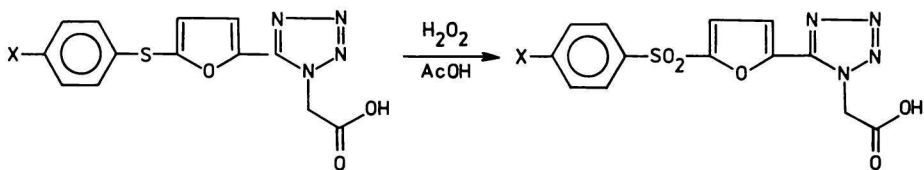
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The 5-[5-(4-X-phenylsulfo)-2-furyl]-1-tetrazolylacetic acids were obtained by oxidation of 5-[5-(4-X-phenylthio)-2-furyl]-1-tetrazolylacetic acids with hydrogen peroxide in concentrated acetic acid.

Посредством окисления 5-[5-(4-X-фенилтио)-2-фурил]-1-тетразолилуксусных кислот перекисью водорода в концентрированной уксусной кислоте были получены 5-[5-(4-X-фенилсульфо)-2-фурил]-1-тетразолилуксусные кислоты.

Our preceding papers [1; 2] concerned the synthesis of 5-[5-(4-X-phenylthio)-2-furyl]-1-tetrazolylacetic acids (*I*) as intermediates in preparation of new semisynthetic cephalosporin antibiotics. The known synthetic procedures for oxidation of sulfides related to furan with hydrogen peroxide in acetic acid to the corresponding sulfones [3—6] were the model processes for oxidation of 5-[5-(4-X-phenylthio)-2-furyl]-1-tetrazolylacetic acids (*I*) to the corresponding 5-[5-(4-X-phenylsulfo)-2-furyl]-1-tetrazolylacetic acids (*II*) in 72—82 % yields (Table 1); the original 5-substituted 1-tetrazolylacetic acids were the *N*-acylating agents for 7-aminocephalosporanic acid (Scheme 1).



Ia-Ie

IIa-IIe

a X = H; *b* X = CH₃; *c* X = CH₃O; *d* X = Cl; *e* X = F

Scheme 1

Table 1
Characterization of acids *Ila—Ile*

Compound	X	Formula	M_r	$w_i(\text{found})/\%$			$w_i(\text{calc.})/\%$			Yield %	M.p. °C	λ_{max} nm	$\frac{\log \varepsilon}{\text{m}^2 \text{mol}^{-1}}$
				C	H	N	C	H	N				
<i>Ila</i>	H	$\text{C}_{13}\text{H}_{10}\text{N}_4\text{O}_5\text{S}$	334.3	46.70	3.01	16.76	46.70	3.01	16.76	72	173—175	223	3.49
<i>Ilb</i>	CH_3	$\text{C}_{14}\text{H}_{12}\text{N}_4\text{O}_5\text{S}$	348.3	46.68	2.93	16.88	48.27	3.47	16.08	82	190—192	278	3.60
<i>Ilc</i>	CH_3O	$\text{C}_{14}\text{H}_{12}\text{N}_4\text{O}_6\text{S}$	364.3	48.04	3.55	16.10	46.15	3.32	15.37	80	214—216	279	3.59
<i>Ild</i>	Cl	$\text{C}_{13}\text{H}_9\text{ClN}_4\text{O}_5\text{S}$	368.7	46.06	3.33	15.33	42.34	2.46	15.19	75	199—201	247	3.52
<i>Ile</i>	F	$\text{C}_{13}\text{H}_9\text{FN}_4\text{O}_5\text{S}$	352.3	44.32	2.57	15.90	42.41	2.40	15.28	72	182—183	281	3.51
				44.23	2.61	15.98						224	3.43
												277	3.58

The IR spectra of acids (*II*) (Table 2) revealed characteristic bands of asymmetric and symmetric stretching vibrations of sulfone grouping at $\tilde{\nu} = 1340\text{--}1350$ and $1144\text{--}1152\text{ cm}^{-1}$, respectively, absorptions indicative of a carbonyl group (at $\tilde{\nu} = 1732\text{--}1740\text{ cm}^{-1}$) and further groupings as C=N, C=C, and N=N (at $\tilde{\nu} = 1495\text{--}1626\text{ cm}^{-1}$) which may interfere. The unequivocal assignment was possible after measuring the IR spectrum of ethyl 1*H*-1-tetrazolylacetate [7] and 5-(2-furyl)-1-tetrazolylacetate [8], which made it clear that bands at $\tilde{\nu} = 1626\text{--}1630\text{ cm}^{-1}$ are due to stretching vibrations of the C=N bond and those at $\tilde{\nu} = 1591\text{--}1598$ and $1498\text{--}1501\text{ cm}^{-1}$ to C=C bonds. The medium strong bands at $\tilde{\nu} = 1089\text{--}1095\text{ cm}^{-1}$ are associated with skeletal vibrations of the disubstituted tetrazole [9, 10]. The presence of a disubstituted furan ring in acids *IIa*—*IIe* was evidenced by characteristic bands of a medium intensity at $\tilde{\nu} = 1290\text{--}1300$ and $1021\text{--}1030\text{ cm}^{-1}$ belonging to the asymmetric and symmetric stretching vibrations of a disubstituted furan ring.

The UV spectra of acids *IIa*—*IIe* disclosed absorption maxima at $\lambda_{\text{max}} = 220\text{--}247$ and $277\text{--}285\text{ nm}$. In comparison with the starting 5-(5-arylthio-2-furyl)-1-tetrazolylacetic acids (*I*) and their ethyl esters [1] a bathochromic shift was observed.

Table 2

IR spectral data ($\tilde{\nu}/\text{cm}^{-1}$) of substituted tetrazolylacetic acids *IIa*—*IIe*

Compound	$\nu(\text{C}=\text{O})$	$\nu_{\text{as}}(\text{SO}_2)$	$\nu_{\text{s}}(\text{SO}_2)$	$\nu(\text{C}=\text{N})$	$\nu(\text{C}=\text{C})$	$\nu(\text{tetrazole})_{\text{skeleton}}$	$\nu_{\text{as}}(\text{C}-\text{O}-\text{C})$
<i>IIa</i>	1732	1344	1144	1630	1598	1094	1299
<i>IIb</i>	1739	1340	1150	1628	1590	1095	1298
<i>IIc</i>	1740	1346	1151	1628	1591	1090	1296
<i>IId</i>	1733	1343	1152	1627	1597	1091	1290
<i>IIe</i>	1738	1350	1148	1629	1592	1093	1300

Experimental

The melting points were measured with a Kofler micro hot-stage. The IR (3 mg of the substance in 200 mg KBr) and the UV spectra (wavelength range 210—250 nm, $c = (6.0\text{--}8.0) \times 10^{-4}\text{ mol dm}^{-3}$ in dioxan) were recorded with Perkin—Elmer, model 457 and 340, spectrophotometers, respectively.

5-[5-(4-*X*-phenylsulfo)-2-furyl]-1-tetrazolylacetic acids (*IIa*—*IIe*)

Hydrogen peroxide (6 cm³; 30 %) was added to a stirred solution of 5-[5-(4-*X*-phenylthio)-2-furyl]-1-tetrazolylacetic acid (10 mmol) in acetic acid (100 cm³) at 40 °C

and the mixture was stirred for additional 30 min. The solution was left standing at room temperature for 5 days, concentrated to one fourth of its original volume, diluted with water (50 cm³) and the separated acid was filtered off, washed with water and crystallized from 50 % ethanol.

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