

Synthesis and properties of 2-hydrazinobenzothiazole derivatives

^aE. HOLBOVÁ and ^bA. PERJÉSSY

^aInstitute of Chemistry, Komenský University,
CS-842 15 Bratislava

^bDepartment of Organic Chemistry, Faculty of Natural Sciences,
Komenský University, CS-842 15 Bratislava

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Dedicated to Professor RNDr. V. Sutoris, CSc., in honour of his 60th birthday

N^{β} -Substituted monohydrazides of dicarboxylic acids were prepared by reacting 2-hydrazinobenzothiazole with anhydrides of dicarboxylic acids. The resulting compounds afforded cyclic N^{α} -acetylated derivatives upon treatment with acetic anhydride. The structure of the new compounds was confirmed by infrared spectra. The chosen compounds of both types were tested as pesticides and as animal growth stimulators.

Получены N^{β} -замещенные моногидразиды дикарбоновых кислот путем реакции 2-гидразинобензотиазола с ангидридами дикарбоновых кислот. Образовавшиеся соединения превращаются в циклические N^{α} -ацетилированные производные в результате их обработки уксусным ангидридом. Строение новых соединений было подтверждено с помощью ИК-спектроскопии. У избранных соединений обоих типов была проверена активность в качестве пестицидов и в качестве стимуляторов роста животных.

A simple procedure for the preparation of 2-hydrazinobenzothiazole [1, 2], an availability of the rest of starting materials as well as a known biological activity of the similar types of compounds [3, 4] prompted us to prepare an additional series of compounds in this field.

Reaction of 2-hydrazinobenzothiazole with anhydrides of dicarboxylic acids gives rise to N^{β} -benzothiazolyl-substituted monohydrazides of dicarboxylic acids (*a*, Scheme 1). The products were obtained in yields ranging from 70 % up to 88 %. They are white solids, well crystallizing from the reaction mixture and melting at about 200 °C. Upon treatment of these compounds with acetic anhydride, cyclization together with N^{α} -acetylation takes place (compounds *b*, Scheme 1). The products *b* were isolated either by concentration of the reaction mixture or by hydrolysis of the excess of acetic anhydride. The analytical data of both groups of compounds are summarized in Table 1. Infrared spectroscopy was used for the structure determination of the compounds under question. The compounds I—V

Table 1

Analytical data of the prepared compounds



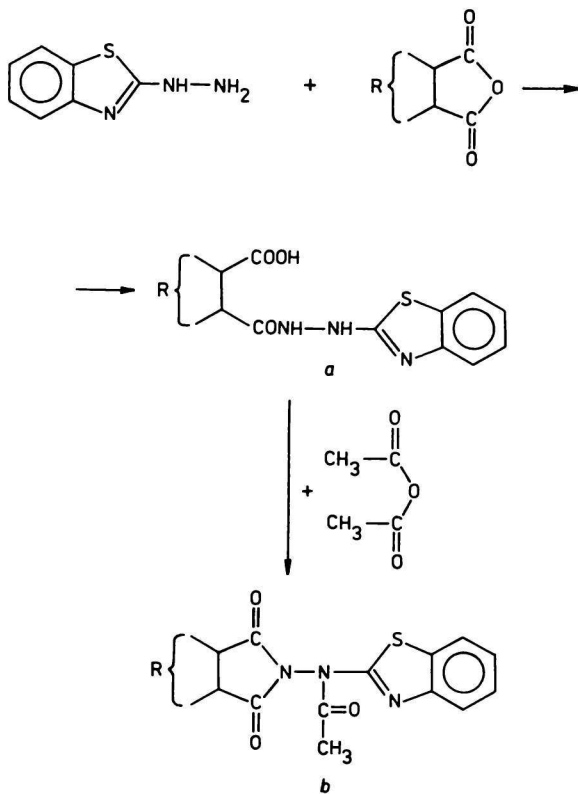
Compound	R		Formula	M_r	$w_i(\text{calc.})/\%$ $w_i(\text{found})/\%$				Yield/%	M.p./°C
	a	b			C	H	N	S		
I	$\begin{array}{c} \text{CH}_2- \\ \\ \text{CH}_2- \end{array}$		$\text{C}_{11}\text{H}_{11}\text{N}_3\text{SO}_3$	265.27	49.80 49.80	4.17 4.13	15.84 15.75	12.08 12.11	70	188—190
II	$\begin{array}{c} \text{CH}_2- \\ / \quad \backslash \\ \text{CH}_2- \end{array}$		$\text{C}_{12}\text{H}_{13}\text{N}_3\text{SO}_3$	279.31	51.59 51.87	4.69 4.73	15.04 14.71	11.47 11.40	68	199—201
III	$\begin{array}{c} \text{CH}- \\ \\ \text{CH}- \end{array}$		$\text{C}_{11}\text{H}_9\text{N}_3\text{SO}_3$	263.27	50.18 50.16	3.44 3.62	15.96 15.97	12.17 12.29	88	186—188
IV	$\begin{array}{c} \text{CH}_2=\text{C}- \\ \\ \text{CH}_2- \end{array}$		$\text{C}_{12}\text{H}_{11}\text{N}_3\text{SO}_3$	277.28	51.97 52.30	3.99 3.97	15.15 15.18	11.56 11.50	60	166—168
V			$\text{C}_{15}\text{H}_{11}\text{N}_3\text{SO}_3$	313.31	57.49 57.60	3.53 3.37	13.41 13.40	10.23 10.18	75	190—192

Table 1 (Continued)

Compound	R		Formula	M_r	$w_i(\text{calc.})/\%$ $w_i(\text{found})/\%$				Yield/%	M.p./°C
	a	b			C	H	N	S		
VI		$\begin{array}{c} \text{CH}_2- \\ \\ \text{CH}_2- \end{array}$	$\text{C}_{13}\text{H}_{11}\text{N}_3\text{SO}_3$	289.29	53.97 54.15	3.83 3.84	14.52 14.48	11.08 11.00	71	180-182
VII		$\begin{array}{c} \text{CH}_2- \\ / \quad \backslash \\ \text{CH}_2 \quad \text{CH}_2- \end{array}$	$\text{C}_{14}\text{H}_{13}\text{N}_3\text{SO}_3$	303.33	55.43 55.75	4.31 4.33	13.85 13.82	10.56 10.32	75	168-171
VIII		$\begin{array}{c} \text{CH}- \\ \\ \text{CH}- \end{array}$	$\text{C}_{13}\text{H}_9\text{N}_3\text{SO}_3$	287.29	54.34 54.17	3.15 3.06	14.62 14.48	11.15 11.16	89	212-214
IX		$\begin{array}{c} \text{CH}_2=\text{C}- \\ \\ \text{CH}_2- \end{array}$	$\text{C}_{14}\text{H}_{11}\text{N}_3\text{SO}_3$	301.32	55.80 56.01	3.67 3.56	13.94 13.95	10.64 10.61	70	194-196
X			$\text{C}_{17}\text{H}_{11}\text{N}_3\text{SO}_3$	337.33	60.52 60.87	3.28 3.27	12.45 12.63	9.50 9.43	90	196-198

show in IR intensive absorption bands at $\tilde{\nu} \approx 1700 \text{ cm}^{-1}$ and at $\tilde{\nu} \approx 1675 \text{ cm}^{-1}$ which can be attributed to the C=O stretching vibrations of carboxylic and amido groups, respectively. Relatively low magnitudes of wavenumbers indicate the presence of both inter- and intramolecular hydrogen bonds between NH, OH and C=O, —N≡ groups. In the case of compound *III*, additional shifts to the lower wavenumbers are observed for both C=O stretching vibrations, caused by conjugation of these groups with the CC double bond. The absorption bands of the stretching vibration of the one of free NH groups (usually that one neighbouring the benzothiazole skeleton) are observed in the region $\tilde{\nu} = 3310\text{—}3340 \text{ cm}^{-1}$. As



Scheme 1

a consequence of the vibrational coupling, the compounds *VI—X* exhibit two absorption bands in the region $\tilde{\nu} = 1720\text{—}1810 \text{ cm}^{-1}$ which can be assigned to antisymmetric and symmetric C=O stretching vibrations in the imide ring. In addition to these bands, the spectra of compounds *VI—X* contain a strong band at $\tilde{\nu} = 1675\text{—}1720 \text{ cm}^{-1}$ belonging to the C=O stretching vibration of the acetyl

group on nitrogen. As it can be seen in Tables 2 and 3, the wavenumbers of characteristic vibrations in both types of compounds are strongly affected by the structure and geometry of the imide ring. The absorption bands of the characteristic vibrations of the benzothiazole skeleton are located at $\bar{\nu} \approx 1500 \text{ cm}^{-1}$ and 1600 cm^{-1} .

Table 2

Wavenumbers of absorption bands of the characteristic vibrations
in infrared spectra of compounds I—V

Compound	$\bar{\nu}/\text{cm}^{-1}$		
	$\nu(\text{C=O})(-\text{CO}-\text{NH}-)$	$\nu(\text{C=O})(-\text{COOH})$	$\nu(\text{NH})_{\text{free}}$
I	1678 s	1705 s	3338 w
II	1676 s	1710 m	3337 w
III	1645 s	1660 sh	a
IV	1675 s	1695 s	3340 w
V	1675 s	1690 sh	3308 m

a) Absorption band is missing probably due to intramolecular hydrogen bonding.

Table 3

Wavenumbers of absorption bands of the characteristic vibrations
in infrared spectra of compounds VI—X

Compound	$\bar{\nu}/\text{cm}^{-1}$			
	$\nu(\text{C=O})(\text{cyclic imide})$	$\nu(\text{C=O})(\text{acetyl})$	$\nu(\text{benzothiazole})$	
VI	1721 s, 1750 m	1680 s	1502 s,	1596 w
VII	1719 s, 1755 m	1700 s	1499 s,	1592 w
VIII	1742 s, 1778 sh	1713 s	1500 m,	1582 w
IX	1770 s	1675 s	1493 m,	1600 sh ^a
X	1754 s, 1809 m	1720 s	1495 s,	1598 w

a) Overlapped with the band of $\text{CH}_2=\text{C}$ stretching vibration at $\bar{\nu} = 1618 \text{ cm}^{-1}$.

Both types of compounds were proved to be less effective pesticides but more effective animal growth stimulators. The highest pesticidal activity was 25 % of the standard. On the other hand, the index of stimulation activity of the compound III was 103.43 while the same magnitudes of the used standard were 110.20, 118.41, and 125.05. The index of activity of compound X was 92.82 with the index of the standard being 121.36.

Experimental

2-Hydrazinobenzothiazole was prepared by the reaction of potassium salt of benzothiazole-2-sulfonic acid with hydrazine hydrate [1]. The used anhydrides of dicarboxylic acids were either commercially available (anhydrides of phthalic and maleic acids) or were prepared by the standard method.

The tests of pesticidal activity were performed at the Research Institute of Chemical Technology, Bratislava and the screening of animal growth stimulators was done at the Research Institute for Biofactors and Veterinary Drugs, Pohoří-Chotoň, Jílové u Prahy.

Infrared spectra were taken on a Specord 75 IR (Zeiss, Jena) instrument in nujol (suspensions of 8 mg of a compound per 30 mg of nujol) in KBr cells. The spectrophotometer was calibrated by a polystyrene reference spectrum. The wavenumbers of the most important characteristic absorption bands are given in Tables 2 and 3.

N^β-Benzothiazolyldiazinocarboxylic acids (I—V)

2-Hydrazinobenzothiazole (3.2 g; 0.020 mol) is dissolved in 150 cm³ of 96 % ethanol by heating. The source of heat is removed and 0.020 mol of an anhydride of dicarboxylic acid is added in small portions with stirring. After 2—3 min the crystallization of the product begins. After cooling to 20 °C the product is collected on the Büchner funnel and washed under suction with water and finally with ethanol.

N^α-Acetyl-N^β-(2-benzothiazolyl)amino imides of dicarboxylic acids (VI—X)

Monohydrazides of acids I—V (0.010 mol) are mixed with 30 cm³ of acetic anhydride and the mixture is heated until the solution is obtained. After cooling the product begins to crystallize. It is isolated either by concentration of the reaction mixture *in vacuo* or by pouring the reaction mixture into 100 cm³ of water. The products were purified by crystallization from a mixture of acetone—water (volume ratio = 1 : 4).

Acetylated derivatives VI—X are soluble in acetone, chloroform, acetic acid, benzene, dimethylformamide, and dimethyl sulfoxide.

Derivatives of carboxylic acids I—V are soluble in dimethyl sulfoxide.

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