FORMAZANS CONTAINING SULFAMIDE GROUPS

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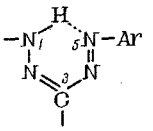
The so-called formazans, with the characteristic formazyl group

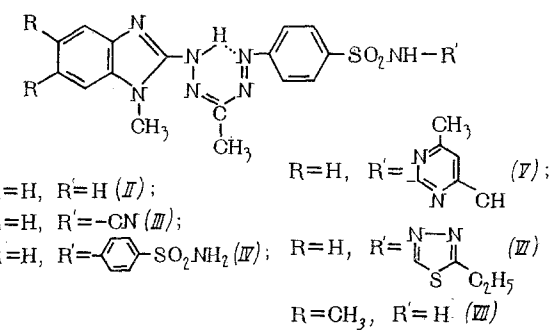


are unique azo dyes.

In the formulation of this work it was assumed that new compounds with antimicrobial action could be produced by introducing a sulfamide group into arylformazans. It was also considered that the formazyl group contains a quasiaromatic chelate ring, capable of forming complexes with metals [1], while complex formation can play a role in the process of bacteriostasis as a result of interaction with metal-containing enzymes of microbes [2].

There are very few literature data on formazans containing sulfamide groups [3, 4]; sulfamide formazans with heteroaromatic radicals are entirely unknown.

In this work we produced formazans in which there is an arylsulfamide at N_5, and a benzimidazolyl residue, encountered in a number of biologically active compounds (vitamin B_{12}, dibazol, etc.), at N_1. The formazans described, with the general formula of (I), may subsequently be used as starting materials for the synthesis of the corresponding tetrazolium salts, among which numerous antibacterial substances and compounds that selectively interact with the biological substrate are already known [5-7]:



where R=H, R'=H (II);
R=H, R'=-CN (III);
R=H, R'=-C6H4-SO2NH2 (IV);
R=H, R'= (V);
R=H, R'= (VI)
R=CH3, R'=H (VII)

Formazans II-VI were produced by azo-combination of diazotized sulfanilamide compounds with the 1-methylbenzimidazolyl-2-hydrazone of acetaldehyde in acid aqueous-alcohol medium.

The formazan VII was produced analogously from diazotized p-aminobenzene-sulfamide and the 1,5,6-trimethylbenzimidazolyl-2-hydrazone of acetaldehyde. The formazans give complex compounds with the metals Cu, Zn, Co, and Ni. Complex compounds with nickel are cited below as an example. The data of the analyses and certain properties of the compounds obtained are presented in Table 1.

EXPERIMENTAL

The formazans II-VII were produced according to the following procedure. A diazo solution (from 0.01 mole of the sulfanilamide) was introduced into a solution of 0.01 mole of the hydrochloride of the alkylbenzimidazolyl-2-hydrazone of acetaldehyde in 50-100 ml of ethanol and 100-300 ml of water, cooled to 0°. A 1N solution of NaOH was slowly added drop-wise with intensive mixing and cooling. The reaction mix-

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TABLE 1. Properties of the Compounds Obtained

Compound	Name of compound	Mp (in deg.) with decomposition, solvent	Yield (in %)	Found (in %)				Gross formula	Calculated (in %)				External appearance	λ_{max} in mμ	E · 10^{-4}
				C	H	N	S		C	H	N	S			
II	1-(1'-Methylbenzimidazolyl-2')-3-methyl-5-(p-sulfamidophenyl)-formazan	231–4, butanol	65	51.96	4.83	26.03	8.98	$C_{16}H_{17}N_7O_2S$	51.73	4.61	26.40	8.63	Red-lilac plates	483	3.40
III	1-(1'-Methylbenzimidazolyl-2')-3-methyl-5-(p-sulfocyanamidophenyl)-formazan	177–9, Pyridine	69	55.56	4.45	26.51	6.74	$C_{17}H_{16}N_8O_2S \cdot C_5H_5N$	55.14	4.28	26.29	6.97	Red plates	488	5.12
IV	1-[(1'-Methylbenzimidazolyl-2')-3-methyl-5-1"-(p-sulfamidophenyl)-4"-sulfamidophenyl]-formazan	229–2, Butanol	67	52.27	5.41	18.44	10.65	$C_{22}Y_{22}N_8O_4S_2 \cdot C_4H_9OH$*	51.98	5.36	18.65	10.67	Red needles	504	4.72
		239–1, DMFA–water		49.67	5.19	20.94	9.98	$C_{22}H_{22}N_8O_4S_2 \cdot C_3H_7NO$	50.06	4.87	21.02	10.09	Red plates		
V	1-[1'-Methylbenzimidazolyl-2']-3-methyl-5-[2"-(p-sulfamidophenyl)-4",6"-dimethylpyrimidyl]-formazan	230–2, Butanol	88	55.41	4.91	26.06	6.70	$C_{22}H_{23}N_9O_2S$	55.32	4.85	26.40	6.71	Red tapered plates	493	4.58
VI	1-[1'-Methylbenzimidazolyl-2']-3-methyl-5'[2"-(p-sulfamidophenyl)-5"-ethyl-3",4"-thiadiazolyl]-formazan	214–6, Ethanol	89	49.96	4.58	26.59	12.55	$C_{20}H_{21}N_9O_2S_2$	49.67	4.37	26.07	13.26	Lilac plates	493	4.42
VII	1-(1',5',6'-Trimethylbenzimidazolyl-2')-3-methyl-5-(p-sulfamidophenyl)-formazan	244–7, Butanol	44	54.39	5.44	24.02	7.75	$C_{18}H_{21}N_7O_2S$	54.11	5.29	24.54	8.02	Red needles	512	5.36

*Butanol found, %: 12.39. Calculated, %: 12.33. After removal of the butanol of crystallization by drying under vacuum over P_2O_5 and paraffin at 130°, found, %: 50.45; H 4.22. Calculated, %: C 50.17; H 4.21.

ture was colored crimson red at pH 2.0-3.0, and a red precipitate formed. The pH of the medium was adjusted to 6.0-7.0. The reaction mixture was kept for 1 h at 0-5°. Then it was filtered and the precipitate washed with water and ethanol. The formazans II-VII are poorly soluble in ethanol and acetone, readily soluble in hot butanol, dimethylformamide (DMFA), pyridine, and in a mixture of ethanol and ammonia. Some of the formazans cited are characterized by an ability to firmly retain molecules of the crystallization component in their composition [8].

The complex compound of 1-(1'-methylbenzimidazolyl-2')-3-methyl-5-(p-sulfamidophenyl)-formazan nickel (VIII). To 0.01 mole of the formazan II in 50 ml of dimethylformamide and 50 ml of water we added 0.015 mole $Ni(NO_3)_2$ in 20 ml of water at 70-80°. The solution was colored blue-green. It was boiled for 15-20 min. Upon cooling, fine needles of a blue-colored complex with a strong copper luster precipitated. The mixture was filtered, and the precipitate washed with ethanol and water. It was crystallized from ethanol. Blue plates with a strong copper luster, mp 278-281° (dec. from ethanol). Yield 45%. Found, %: C 46.57; H 4.26; N 23.48; Ni 7.19; H_2O 3.54. $(C_{16}H_{16}N_7O_2S)_2 \cdot Ni \cdot 1^1/2\ H_2O$. Calculated, %: C 46.49; H 4.26; N 23.72; Ni 7.10; H_2O 3.26. After removal of the water of crystallization by drying under vacuum over P_2O_5, found, %: N 24.53. Calculated, %: N 24.52; λ_{max} 440 mμ ($\varepsilon 10^{-4} \cdot 1.22$), 660 mμ (6, 10).

The complex compound of 1-[1'-methylbenzimidazolyl-2']-3-methyl-5-[2"-(p-sulfamidophenyl)-4", 6"-dimethylpyrimidyl]-formazan with nickel (IX) was produced analogously from the formazan V. Blue needles with a strong copper luster, mp 273-276° (dec. from ethanol). Yield 50%. Found, %: C 52.15; H 4.66; N 25.02; Ni 5.48. $(C_{22}H_{22}N_9O_2S)_2 \cdot Ni$. Calculated, %: C 52.33; H 4.39; N 24.97; Ni 5.81. λ_{max} 436 mμ ($\varepsilon 10^{-4} \cdot 1.10$), 653 mμ ($10^{-4} \cdot 4.94$). The complexes VIII-IX are readily soluble in hot ethanol, DMFA, and pyridine. The spectra of compounds II-IX were taken on an SF-10 instrument in solutions of DMFA at a concentration of 10^{-4} M.

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