SUBSTITUTION IN BARBITURIC ACIDS

II. Condensation of Thiobarbituric Acid with Oxo Compounds*

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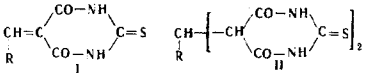
Aromatic and aliphatic aldehydes readily condense with thiobarbituric acid to form 5-arylidenethiobarbituric acids or 5-arylidenebis(thiobarbituric acid)s. A longer time is required for condensation with ketones. The UV spectra of the arylidene derivatives have two absorption bands, with maxima at 240–275 and 280–405 nm, while the spectra of the alkylidene derivatives only one absorption band, with a maximum at 280–295 nm.

In part I [1], the products of the condensation of barbituric acid with various oxo compounds were described. Similar studies with thiobarbituric acid have been carried out in the present work. Such condensations have been described in the literature [2, 3], but the investigations were incomplete and the UV spectra of the products obtained were not determined.

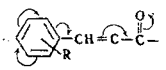
When hot solutions of thiobarbituric acid and aromatic aldehydes in ethanol containing 12% HCl are mixed, in the majority of cases there is a rapid separation of the condensation products in the form of precipitates. The reactions take place mainly with the formation of substances I (table). The condensation of thiobarbituric acid with cinnamaldehyde and aldehydes of the furan series takes place very readily, as in the case of the aromatic aldehydes, and the condensation products precipitate directly when solutions of the components are mixed.



I II

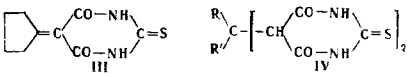
However, the use of salicyladehyde in the reaction leads to the formation of the 5-arylidenebis(thiobarbituric acid)s (II, R = o-HOC_6H_4). The products of condensation with aliphatic aldehydes can be isolated only by evaporating the reaction mixtures. They are substances with the general structure I or II (table).

The UV spectra of the 5-arylidene derivatives retain the "thioamide" maximum in the 250–272 nm region. However, the introduction of arylidene groupings leads to the appearance of a K-absorption band with maxima in the 280–342 nm region, which is due to the formation of a new chain of conjugation.



Some arylidene derivatives, namely the p-bromobenzylidene and salicylylidene derivatives, have a characteristic inflection instead of a maximum in the K-absorption region. In addition, the spectrum of the p-dimethylaminobenzylidene derivative has still another absorption maximum.

As a rule, the condensation of thiobarbituric acid with ketones requires prolonged boiling with an excess of the oxo compounds and subsequent evaporation of the reaction mixture. An exception is condensation with cyclopentanone, since in this case there is an almost instantaneous separation of the 5-cyclopentylidene derivative in the form of a precipitate. The substance obtained is the mono derivative III, while the other products of condensation with ketones are bis derivatives of structure IV. The UV spectra of these compounds have only one absorption band, with maxima at 280–295 nm.



III IV

EXPERIMENTAL

Condensation of thiobarbituric acid with aldehydes. At ~60° C, 0.01 mole of aldehyde in 10 ml of 12% ethanolic HCl was added to a solution of 0.01 mole of thiobarbituric acid in 15–90 ml of the same HCl solution. In the case of aldehydes of the aliphatic and furan series, 10 ml of water and 10 ml of ethanol were added to the reaction mixture. The mixture was boiled under reflux for from 15 min to 6 hr. After cooling, the precipitate was filtered off, washed with water and ether, and crystallized from aqueous ethanol. Where aliphatic aldehydes were used in the reaction, the mixture was evaporated to small volume.

Condensation of thiobarbituric acid with ketones. With heating, 0.01 mole of thiobarbituric acid was dissolved in a mixture of 30 ml of 12% ethanolic HCl and 10 ml of water. A tenfold excess of the appropriate ketone was added to the resulting solution and the mixture was boiled under reflux for 1–6 hr and evaporated to small volume. Then the condensation product was filtered off, washed with ethanolic HCl solution, and crystallized from aqueous ethanol.

The UV absorption spectra of the substances synthesized were recorded by means of an SF-4 spectrophotometer using $(0.2-0.4) \times 10^{-6}$ M solutions prepared in double-distilled ethanol.

REFERENCES

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4. N. M. Turkevich and A. F. Minka, ZhOKh, 35, 884, 1965.

*For part I, see [1].

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Products of the Condensation of Thiobarbituric Acid with Various Aldehydes and Ketones

General formula	R	R′	Mp, °C	Empirical Formula	Found, %		Calculated, %		λmax, nm	log ε	Yield, %
					N	S	N	S			
I	C_6H_5	—	217	$C_{11}H_8N_2O_2S$	12.01	13.96	12.06	13.79	250, 280	4.18, 4.24	82.0
I	p-$O_2NC_6H_4$	—	245	$C_{11}H_7N_3O_4S$	14.98	11.46	15.16	11.57	272, 340	4.20, 4.12	54.9
I	p-ClC_6H_4	—	240	$C_{11}H_7ClN_2O_2S$	10.61	11.96	10.50	12.02	263, 290	4.24, 4.27	43.0
I	p-BrC_6H_4	—	248 (decomp.)	$C_{11}H_7BrN_2O_2S$	9.32	10.21	9.00	10.31	265, 310	4.32, inflec.	59.0
I	p-$(CH_3)_2NC_6H_4$	—	243	$C_{12}H_{13}N_3O_2S$	15.37	12.18	15.26	12.01	245, 285, 342	4.06, 4.10, 4.18	56.0
II	o-HOC_6H_4	—	205	$C_{15}H_{12}N_4O_5S_2$	13.21	16.31	13.58	16.42	260, 310	4.17, inflec.	62.0
I	$C_6H_5CH:CH$	—	235	$C_{13}H_{10}N_2O_2S$	10.74	12.28	10.84	12.41	260, 405	4.17, 4.58	92.0
I	2-Furyl	—	215	$C_9H_6N_2O_3S$	12.50	14.32	12.60	14.43	395	4.32	96.3
I	4-CH_3-Furyl	—	280 (decomp.)	$C_{10}H_8N_2O_3S$	11.85	13.52	11.85	13.57	260, 405	3.82, 4.47	76.3
I	2-Furyl=CH=C(CH_3)	—	235	$C_{12}H_{10}N_2O_3S$	11.01	12.04	10.68	12.22	250, 400	4.20, 4.52	69.2
I	Cl_3C	—	190	$C_6H_3Cl_3N_2O_2S$	10.29	11.62	10.24	11.72	290	4.10	15.0
II	$CH_3CH_2CH_2$	—	205	$C_{12}H_{14}N_4O_4S_2$	16.82	18.61	16.46	18.72	287	4.11	75.8
I	$(CH_3)_2CH$	—	160	$C_8H_{10}N_2O_2S$	14.01	16.01	14.13	16.17	280	4.23	60.6
II	$(CH_3)_2CHCH_2$	—	205	$C_{13}H_{16}N_4O_4S_2$	15.67	17.71	15.72	17.99	285	4.23	40.1
IV	CH_3	CH_3	270 (decomp.)	$C_{11}H_{12}N_4O_4S_2$	17.36	19.99	17.06	19.83	280	4.43	37.0
IV	CH_3	C_2H_5	270 (decomp.)	$C_{12}H_{14}N_4O_4S_2$	16.62	18.96	16.35	18.70	285	4.36	29.0
III	—	—	250 (decomp.)	$C_9H_{10}N_2O_2S$	13.58	15.90	13.20	15.71	295	4.08	95.2
IV	γ-Methyltetramethylene		270 (decomp.)	$C_{15}H_{16}N_4O_4S_2$	14.83	16.44	14.64	16.72	285	4.18	40.3