A Note on the Ring-Chain Tautomerism in the Reaction Products of o-Aminophenol and Some Ethoxymethyleneacetates

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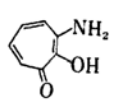
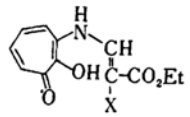
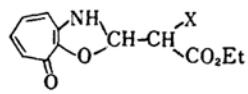
In the preceding paper[1], it was shown that the condensation reaction of 3-aminotropolone (I) and ethyl ethoxymethylenemalonate or some ethoxymethyleneacetates afforded, not the anticipated vinylaminotropolone (II), but its ring-tautomer, dihydro-oxazolotropone (III). This conclusion was drawn from the facts that the above condensation products did not show any coloration with ferric chloride test and were inert to the action of diazomethane, and that their pyrolyses resulted in a fragmentation to oxazolo[5:4-b]tropone (IV) and respective acetic acid derivatives. The authors stated, moreover, that the condensation products III probably exist in the chain-forms of II (or their possible azomethine type of isomers) in an alkaline medium.



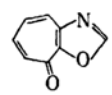
I



(X=CO_2Et, CN, $COCH_3$)
II



(X=CO_2Et, CN, $COCH_3$)
III



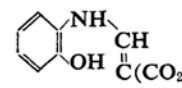
IV

There are not many systematic studies on the ring-chain tautomerism involving a nitrogen atom. Holly and Cope[2] elucidated this problem in the condensation products of *o*-aminobenzyl alcohol or *o*-hydroxybenzylamine with aldehydes or ketones through ultraviolet spectra and molecular refractions. Witkop and Beiler[3] also discussed this tautomerism in the arylidene Schiff bases derived from *o*-aminobenzyl alcohol through the spectral measurements.

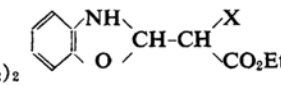
From the above point of view, the present authors have felt interest in a possible ring-chain tautomerism between the condensation products of *o*-aminophenol, analogous to 3-aminotropolone (I), and ethoxymethyleneacetates. In this series of experiments, the authors have obtained information similar to that in the case of the aminotropolone; these will be described below in brief.

Condensations of anilines and ethoxymethyleneacetates have been often carried out for many syntheses of quinolines[4] and for identifications of anilines[5], but no report seems to have been made on the condensation of *o*-aminophenol and ethoxymethyleneacetates.

On being heated with ethyl ethoxymethylenemalonate, *o*-aminophenol afforded a condensation product of colorless crystals, m. p. 140~141°C, in a good yield. It did not show any coloration with alcoholic ferric chloride and was inert to the action of diazomethane. As might have been expected from the conclusions in the case of 3-aminotropolone (I), the above experimental results show that the condensation product is not the anticipated vinylaminophenol (V) or its possible isomer of the Schiff base type but is presumably 2-(ω, ω-diethoxycarbonylmethyl)benzoxazoline (VI). The reaction product, moreover, resulted in fission to form benzoxazole and ethyl malonate on pyrolysis, and this fact probably affords a more powerful proof for the assignment of structure VI to the condensation product.



V



VI: X=CO_2Et
VII: X=$COCH_3$
VIII: X=CN

The ultraviolet absorption of the compound VI in an alkaline solution has maxima at longer wavelength region than in a neutral solution (Fig. 1). This fact indicates probably that the compound VI may exist in the chain-form of V (or its isomeric Schiff base) in an alkaline medium, the conclusion of which is analogous to that of the case in the condensation products of 3-aminotropolone[1].

The use of ethoxymethyleneacetoacetate and ethoxymethylenecyanoacetate, in place of

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1) T. Nozoe, K. Doi and K. Kitahara, This Bulletin, **34**, 611 (1961).
2) F. W. Holly and A. C. Cope, *J. Am. Chem. Soc.*, **66**, 1875 (1944).
3) B. Witkop and T. W. Beiler, ibid., **76**, 5589 (1954).
4) R. H. Reitsma, *Chem. Revs.*, **43**, 43 (1948).
5) G. R. Lappin, *J. Chem. Educ.* **28**, 126 (1951).

ethoxymethylenemalonate, in this condensation reaction afforded the respective benzoxazoline VII and VIII in a good yield. These structures were presumed from the facts that their ultraviolet absorptions were similar to that of the compound VI and that their pyrolyses yielded benzoxazole.

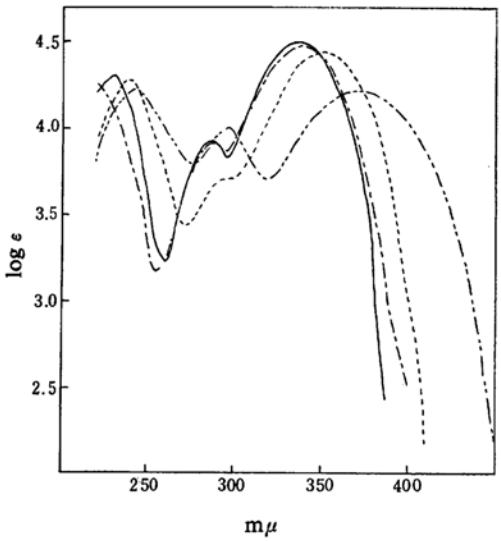

Fig. 1. Ultraviolet absorption spectra in methanol: curve —— VI; curve ---- VII; curve ——— VIII; curve ——— VI in 0.1 N sodium hydroxide solution.

Experimental

The ultraviolet absorptions were measured in methanol, unless otherwise stated, with a Beckman model DU spectrophotometer.

2-(ω, ω-Diethoxycarbonylmethyl)benzoxazoline (VI). — A mixture of *o*-aminophenol (1.1 g.) and ethyl ethoxymethylenemalonate (2.2 g.) was heated on an oil bath at 130°C for 30 min., and then the residual solid was recrystallized from ethanol to form the benzoxazoline VI as colorless prisms, m. p. 140~141°C, in a nearly quantitative yield.

Found: C, 60.11; H, 5.72; N, 5.04. Calcd. for $C_{14}H_{17}O_5N$: C, 60.20; H, 6.14; N, 5.02%.

λ_{max} mμ (log ε): in methanol, 230 (4.30), 286 (3.92), 335 (4.49); in 0.1 N sodium hydroxide, 243 (4.23), 295 (4.00), 370 (4.23).

Pyrolysis of the Compound VI. — The above benzoxazoline VI (5.6 g.) was placed in a Claisen flask with a small capacity and heated on an oil bath at 250°C. Vigorous boiling occurred and colorless liquid distilled out, which was separated into the two fractions by their boiling points at ordinary pressure: a) b. p. 175~185°C, 1.6 g., and b) b. p. 195~199°C, 2.7 g. Fraction (a) was distilled once again and the portion boiled at 180~182°C was collected. The cooled distillate crystallized to give benzoxazole (0.97 g.), alone and mixed m. p. 30~31°C[6]. The fraction (b), with an odor like that of ethyl malonate, afforded malonic dianilide, alone and mixed m. p. 275°C[7], on being heated with excess of aniline at 150°C.

2-(ω-Acetyl-ω-ethoxycarbonylmethyl)benzoxazoline (VII).—A mixture of *o*-aminophenol (1.1 g.) and ethyl ethoxymethyleneacetoacetate (1.9 g.) was heated at 130°C for 20 min. and the residual solid was recrystallized from methanol to give the benzoxazoline (VII) as colorless prisms, m. p. 146~147°C, in a good yield.

Found: C, 62.66; H, 5.98; N, 5.61. Calcd. for $C_{13}H_{15}O_4N$: C, 62.64; H, 6.07; N, 5.62%.

λ_{max}^{MeOH} mμ (log ε): 238 (4.28), 350 (4.45).

VII resulted in the formation of benzoxazole and ethyl acetoacetate, identified as its anilide[8], on pyrolysis at 250°C.

2-(ω-Ethoxycarbonyl-ω-cyanomethyl)benzoxazoline (VIII). — An equimolar mixture of *o*-aminophenol and ethyl ethoxymethylenecyanoacetate was heated at 100°C for 30 min. and the residual solid crystallized from methanol to form the benzoxazoline (VIII) as colorless needles, m. p. 191~192°C, in a good yield.

Found: C, 62.04; H, 5.04; N, 11.90. Calcd. for $C_{12}H_{13}O_3N_2$: C, 62.06; H, 5.21; N, 12.06%.

λ_{max}^{MeOH} mμ (log ε): 287 (3.91), 340 (4.47).

Pyrolysis of the compound VIII at 250°C gave also benzoxazole and ethyl cyanoacetate, identified as its amide[9].

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