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REACTION OF ENAMINES OF THE ISOCHOLINE AND PHENANTHRIDINE SERIES WITH OXALYL CHLORIDE

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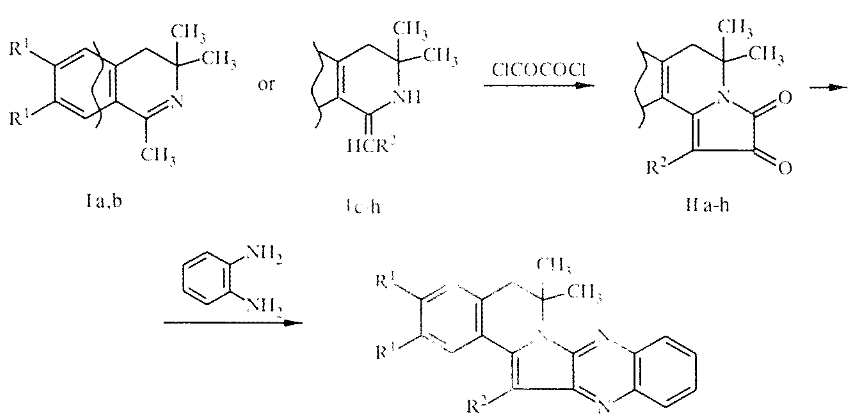
Compounds of the 2,3-dioxopyrrolo[2,1-a]isoquinoline and 2,3-dioxopyrrolo[1,2-f]phenanthridine series were synthe-sized and the products of their condensation with o-phenylenediamine were obtained.

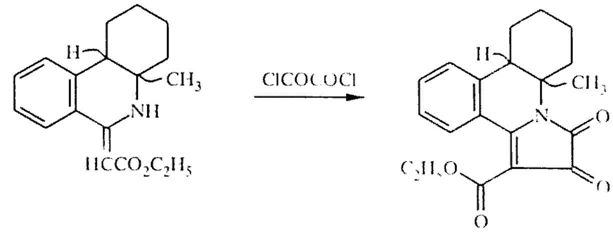
We previously obtained derivatives of 2,3-dioxopyrollo[2,1-*a*]isoquinoline [1-3] with phenyl and carbamoyl groups and hydrogen as the substituent in position 1. The synthetic possibilities for substances with this structure are basically limited by reactions of the dicarbonyl fragment of the pyrrole ring. At the same time, compounds of this type activated at the $C_{(1)}$ atom by ester [4, 5] or ketone groups are known as dienophiles for the key stage of synthesis of analogs of erythrinan alkaloids [4-7], and the carbonyl in the side chain itself has functional capabilities.

Enamines of the phenanthridine series are a new group of enamines [8]. The reaction of these compounds with oxalyl chloride can be used for obtaining complex polycyclic systems. We investigated the reaction of oxalyl chloride with enaminocarbonyl compounds of the isoquinoline and phenanthridine series.

Compounds Ia-f, described previously, and unknown enamines Ig, h, IV, and VI were used as the starting enamines for comparing the reactivity.



III



IV

V

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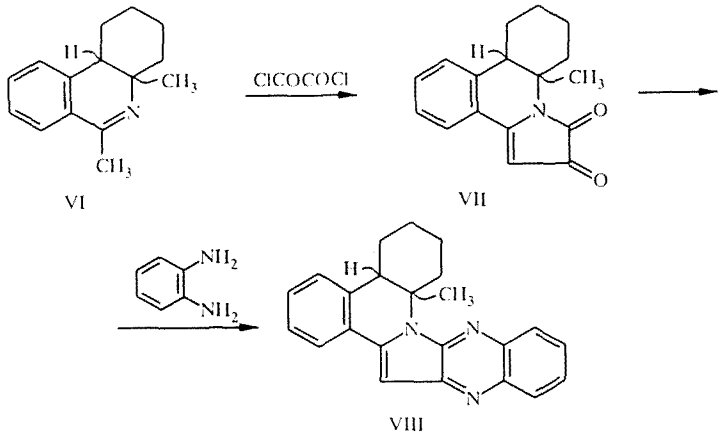

The studies showed that the reaction of enamines Ia-h with oxalyl chloride takes place with the same good yields (Table 1) with both azomethines Ia, b and with compounds in which the structure of the enamine is fixed. In the case of ketone Ih, the $C(O)CCl_3$ acceptor group significantly decreases the yield of the product of the reaction, perhaps due to a decrease in the electron density on the β-carbon atom of the enamine group. The presence of OCH_3 groups does not affect the course of the reaction; substances containing this substituent (compounds IIb, d, e) have higher melting points than corresponding compounds IIa [1], c, e [1] which do not contain these groups.

In the case of phenanthridines IV and VI, the yields reported in Table 1 were obtained with a longer reaction time than in the case of isoquinolines. This decrease in reactivity could be due to a decrease in the degree of conjugation of the N—C=C system after completion of the carbon skeleton of the $(CH_2)_4$ chain and with greater steric hindrance at the phenanthridine $C_{(4a)}$ atom than at the isoquinoline $C_{(3)}$ atom. The method of obtaining compounds V and VII is a new method for synthesizing the pyrrolo[1,2-f]phenanthridine system [9, 10].

These compounds were reacted with o-phenylenediamine in glacial acetic acid to characterize the dioxopyrrolines obtained [3]. Substances with no carbonyl group in the side chain were used in the reaction, since a new reaction site would appear otherwise. In the reaction of compounds IIa [3], IIb, and VII with o-phenylenediamine, the corresponding quinoxaline derivatives III and VIII were obtained.

The PMR spectra of the previously unknown compounds (Table 2) are similar to the spectra described in [1-3]. Initial substances IV and VI are an enantiomeric pair [8]. Signals of an 8*a*-H enantiotopic proton and the 4*a*-CH_3 enantiotopic group are present in the PMR spectra of corresponding polycyclic derivatives V, VII, and VIII. In the PMR spectra of compounds IIIb and VIII, note the shift of the singlet signal of the 1-H proton to the stronger field in comparison to quinoxaline IIIa (by more than 6.87 ppm [3]) — respectively 6.68 and 7.07 ppm, which could be due to the electron-donor effect of the OCH_3 and $(CH_2)_4$ groups.

Absorption bands of a cyclic ketone group (1735-1755), lactam carbonyl (1700-1710 cm^{-1}), and the corresponding carbonyl groups in the side chain are observed in the IR spectra of compounds IIa-h, V, and VII (Table 2).

TABLE 1. Characteristics of Compounds IIb-h, III, V, VII, and VIII

Compound	R^1	R^2	Empirical formula	mp, °C	Yield, %
IIb	OCH_3	H	$C_{16}H_{17}NO_4$	199...200	77
IIc	H	$CO_2C_2H_5$	$C_{17}H_{17}NO_4$	125...126	87
IId	OCH_3	$CO_2C_2H_5$	$C_{19}H_{19}NO_6$	161...162	83
IIe	H	$C(O)N(CH_2)_4$	$C_{19}H_{20}N_2O_3$	214...215	82
IIf	OCH_3	$C(O)N(CH_2)_4$	$C_{21}H_{24}N_2O_5$	216...217	71
IIg	H	$C(O)C_6H_5$	$C_{21}H_{17}NO_3$	231...232	78
IIh	H	$C(O)CCl_3$	$C_{16}H_{12}Cl_3NO_3$	173...174	57
III	OCH_3	H	$C_{22}H_{21}N_3O_2$	153...155	47
V	—	—	$C_{20}H_{21}NO_4$	163...164	75
VII	—	—	$C_{21}H_{24}N_2O_5$	142...144	53
VIII	—	—	$C_{23}H_{21}N_3$	183...185	60

TABLE 2. Parameters of the PMR and IR Spectra of Compounds IIb-h, III, V, VII, and VIII

Compound	PMR spectrum, δ, ppm					IR spectra, cm^{-1}		
	5-$(CH_3)_2$ s	6-(CH_2) s	aromatic protons	2-CH_3O d	other signals	ketone C=O, ring	lactam C=O	C=O of side chain
IIb	1,53	2,81	6,66, 7,06	3,89	5,65, s HC=C—N	1735	1705	—
IIc	1,44	2,90	7,00...8,01	—	1,17, t, $\underline{CH_3}CH_2$; 4,17, q, $CH_3\underline{CH_2}$	1750	1700	1730
IId	1,46	2,85	6,67, 7,20	3,85	1,28, t, $\underline{CH_3}CH_2$; 4,27, q, $CH_3\underline{CH_2}$	1750	1700	1730
IIe	1,46	2,92	7,03...7,96	—	1,61...1,92, m $(CH_2)_2$; 3,35...3,60, m $2CH_2$—N	1740	1705	1635
IIf	1,17	2,57	6,43, 6,93	3,70	1,52...1,83, m $(CH_2)_2$; 3,32...3,87, m $2CH_2$—N	1740	1705	1640
IIg	1,70	3,07	7,07...8,06	—	—	1745	1700	1640
IIh	1,53	2,92	7,04...7,73	—	—	1755	1705	1685
III	1,83	3,00	6,86, 7,27	3,93	6,68, s, HC=C-	—	—	—
V	—	—	7,10...8,27	—	1,00, br.s $(CH_2)_4$; 1,60, br. s, 4a-CH_3; 1,23, t, $\underline{CH_3}CH_2$; 4.33, q $CH_3\underline{CH_2}$; 2.56, m 8a-H	1755	1705	1725
VII	—	—	7,26...7,69	—	1,11, br.s . $(CH_2)_4$; 1,40, br. s, 4a-CH_3; 2,60, m, 8a-H; 5,82, s, HC=C—N	1735	1710	—
VIII	—	—	7,19...7,60	—	1,24, br.s . $(CH_2)_4$; 1,57, br.s 4a-CH_3; 2,60, m, 8a-H; 5,82, s, HC=C—N	—	—	—

EXPERIMENTAL

The PMR spectra were recorded on a Tesla BS-587A (80 MHz) in $CDCl_3$, HMDS internal standard, and the IR spectra were recorded on a UR-20 in $CHCl_3$. The course of the reactions was monitored by TLC on Silufol UV-254 plates in the acetone—ethanol—chloroform system, 1:3:6, development with bromine vapors.

Synthesis of initial enamines Ia-h and compounds IIa, IIIa, IV, and VI is described in [8, 11-14]. All of the substances were recrystallized from isopropyl alcohol.

The data from elemental analysis for C, H, N, and Cl correspond to the calculated data.

2,3-Dioxo-5,5-dimethyl-8.9-(R^1-R^2-2,3,5,6-tetrahydropyrrolo[2,1-*a*]isoquinolines (IIb-h), 2,3-dioxo-4*a*-methyl-1-carbethoxy-2,3,4,4*a*,5,6,7,8*a*-octahydropyrrolo[1,2-f]phenanthridine (VII). A mixture of 10 mmole of enamine Ib-h and 2.76 ml (20 mmole) of triethylamine in 150 ml of ether was added to 0.86 ml (10 mmole) of oxalyl chloride in 50 ml of absolute ether at 0-5°C over 15 min. The reaction mixture was held at the same temperature for another 20 min, heated to 20°C, and left at this temperature for 2 h (enamines Ib-h) or 4 h (compounds V, VII). The precipitated sediment was filtered off, washed with water, dried, and recrystallized.

5,5-Dimethyl-2,3,5,6-tetrahydro-(3,4-dimethoxybenzo)[g]quinoxalino[2,3-b]indolizine (IIIb) and 5-methyl-5,6-tetramethylene-2,3,5,6-tetrahydrobenzo[g]quinoxalino[2,3-b]indolizine (VIII). Here 1.08 g (10 mmole) of o-phenylenediamine was added to a solution of 10 mmole of compound IIb or VII in 20 ml of glacial acetic acid. The mixture was boiled for 2 h, cooled, and the precipitated sediment was filtered off, dried, and recrystallized.

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