

Maleic acid, maleamic acid, *trans*-crotonyl urea, and *trans*-cinnamyl urea reacted with bromine water to form dibromo addition products. Succinic acid did not react with bromine.

Chlorine water reacted with tribromopyruvyl urea to form an N-chloro-tribromopyruvyl urea.

Iodine did not react with maleic acid. Iodine bromide in water at 0–10° reacted with maleic acid to form a monoiodo derivative, which on further treatment with iodine bromide at about 30° yielded triiodopyruvyl urea.

Bromination of the monoiodo derivative yielded tribromopyruvyl urea, while treatment of the monobromide with iodine bromide solution gave triiodopyruvyl urea.

Tribromopyruvyl urea upon alkaline hydrolysis yielded bromoform.

Preliminary experiments on rats showed that the administration of tribromopyruvyl urea by mouth produced a mild sedation. Bacteriological tests indicated that N-chloro-tribromopyruvyl urea had an antiseptic action.

COLUMBUS, OHIO

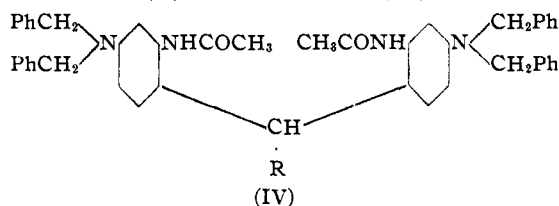
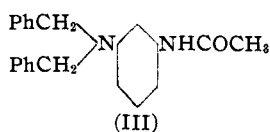
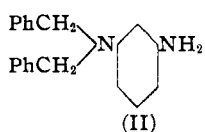
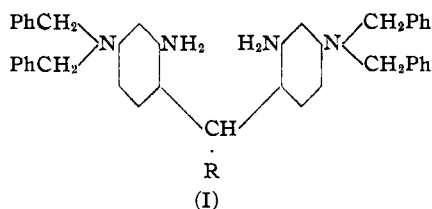
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[CONTRIBUTION FROM THE ORGANIC CHEMICAL LABORATORY OF THE UNIVERSITY OF FLORIDA]

Reactions of Aldehydes with Amines. III. With *N,N*-Dibenzyl-*N'*-acetyl-*m*-phenylenediamine¹

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In an attempt to prepare a series of 5-substituted-2,8-tetrabenzylamino-acridines, it became necessary to synthesize, as intermediates, compounds of formula (I), where R is hydrogen, alkyl, or aryl.



A search of the literature revealed that analogous compounds are produced by condensing *m*-di-

amines such as *m*-phenylenediamine³ and *m*-tolyl-enediamine⁴ with aldehydes. From formaldehyde and *m*-tolylenediamine⁵ is obtained a diphenylmethane derivative from which Acridine Yellow may be prepared by cyclization. When *N,N*-dialkyl-*m*-phenylenediamines are used, the condensation occurs para to the substituted amine group. Thus bis-(2-amino-4-dimethylamino)-diphenylmethane is obtained from *N,N*-dimethyl-*m*-phenylenediamine and formaldehyde.⁶

No difficulty was envisioned in condensing *N,N*-dibenzyl-*m*-phenylenediamine (II) with aldehydes to form series (I). The compound (II) was prepared by the method described in the second paper⁷ of this series and treated with aldehydes under conditions usually used for this type of condensation. However, the aldehydes condensed with the amine hydrogens and produced Schiff bases instead of (I). Since these reactions failed to produce (I) because of the reactivity of the primary amine group, the acetyl derivative (III) of (II) was prepared and substituted for the free amine. Under these conditions compounds of structure (IV) were isolated. The benzoyl derivative of (II) acts in the same manner. Experiments now being carried out show that these compounds are readily cyclized to acridines.

(1) This paper is abstracted from a portion of a dissertation submitted by F. G. Singleton to the Graduate Council of the University of Florida in partial fulfillment of the requirements for the degree of Doctor of Philosophy, August, 1940.

(2) Present address: Kansas State College, Manhattan, Kansas. Part of this work was done in the laboratory of Mme. Ramart-Lucas, professor at the Sorbonne, while Mr. Singleton was Research Fellow (1938–39) of the Société des Amis de l'Université de Paris.

(3) German Patent 45,294.

(4) German Patent 45,298.

(5) Ullmann and Maric, *Ber.*, **34**, 4307 (1901).

(6) German Patent 59,179.

(7) Singleton and Pollard, *THIS JOURNAL*, **63**, 240 (1941).

TABLE I
SUBSTITUTED DIPHENYL- AND TRIPHENYLMETHANES OF FORMULA IV

R	Appearance	Yield, %	Color reaction ^a	M. p. cor., °C.	Formula	Analyses, % N Calcd.	Found
Phenyl	White powder	49	Green	228	C ₅₁ H ₄₈ N ₄ O ₂	7.48	7.41
2-Chlorophenyl	White powder	66	Green	242	C ₅₁ H ₄₇ N ₄ O ₂ Cl	7.14	7.03
4-Chlorophenyl	White powder	58	Green	248	C ₅₁ H ₄₇ N ₄ O ₂ Cl	7.14	7.09
3,4-Dimethoxyphenyl	White leaflets	54	Violet	231	C ₅₈ H ₅₂ N ₄ O ₄	6.93	6.83
2-Methoxyphenyl	White powder	67	Blue	244	C ₅₂ H ₅₀ N ₄ O ₃	7.20	7.19
4-Methoxyphenyl	White powder	40	Blue	224	C ₅₂ H ₅₀ N ₄ O ₃	7.20	7.11
3-Methylphenyl	White leaflets	80	Green	216	C ₅₂ H ₅₀ N ₄ O ₂	7.35	7.30
4-Methylphenyl	White powder	65	Green	218	C ₅₂ H ₅₀ N ₄ O ₂	7.35	7.28
3-Methoxy-4-hydroxy-phenyl	White powder	48	Violet	196	C ₅₂ H ₅₀ N ₄ O ₄	7.05	6.99
3,4-Methylenedioxy-phenyl	White leaflets	44	Violet	225	C ₅₂ H ₄₈ N ₄ O ₄	7.07	6.93
2-Nitrophenyl	Yellow leaflets	46	Green	239	C ₅₁ H ₄₇ N ₆ O ₄	8.83	8.70
3-Nitrophenyl	Yellow leaflets	60	Green	211	C ₅₁ H ₄₇ N ₆ O ₄	8.83	8.72
4-Nitrophenyl	Yellow leaflets	70	Green	251	C ₅₁ H ₄₇ N ₆ O ₄	8.83	8.80
2-Chloro-5-nitro-phenyl	Yellow leaflets	64	Green	240	C ₅₁ H ₄₆ N ₆ O ₄ Cl	8.45	8.33
Hydrogen	White powder	70	None	241	C ₄₅ H ₄₄ N ₄ O ₂	8.33	8.10
Methyl	White powder	76	None	172	C ₄₆ H ₄₆ N ₄ O ₂	8.17	8.08
Ethyl	White leaflets	57	None	230	C ₄₇ H ₄₈ N ₄ O ₂	8.00	7.92
Propyl	White powder	50	Yellow	245	C ₄₈ H ₅₀ N ₄ O ₂	7.84	7.82
<i>n</i> -Amyl	White powder	24	Green	201	C ₅₃ H ₅₄ N ₄ O ₂	7.55	7.44
Benzyl	White powder	57	Green	184	C ₅₃ H ₅₂ N ₄ O ₂	7.22	7.11

^a These compounds give the colors listed when irradiated with sunlight either in the solid state or in dioxane solution. The same colors appear when acetic acid solutions of the substances are heated.

Compounds of structure (IV) are described in Table I.

Experimental Part

N,N-Dibenzyl-*N'*-acetyl-*m*-phenylenediamine (III).—One mole of (II) was treated with four moles of acetic anhydride at room temperature and was allowed to stand for twenty-four hours. Filtration and recrystallization from ethanol gave 84% of (III), m. p. 144–145°.

Anal. Calcd. for C₂₂H₂₂N₂O: N, 8.48. Found: N, 8.41.

Substituted Diphenyl- and Triphenylmethanes of Formula (IV).—Aldehydes were refluxed with (III) in alcohol solution with sulfuric acid as condensing agent. Sealed tubes were used for volatile aldehydes. Yields were increased by tripling the calculated quantity of aldehyde and using a relatively large quantity of alcohol. The yields were lowered by the formation of three secondary products. (1) Schiff bases⁷ were formed following partial hydrolysis of (III) to (II). (2) Acridines were formed by cyclization of small amounts of (IV). (3) Carbinol bases

were formed by oxidation of small amounts of (IV). Separation was based on the insolubility of series (IV) in alcohol. A sample procedure is given below.

2,2' - bis - Acetamino - 4,4' - bis - dibenzylamino - 4'' - chlorotriphenylmethane.—Six and six-tenths grams (0.02 mole) of (III) was dissolved in 250 ml. of alcohol and 4.2 g. (0.03 mole) of *p*-chlorobenzaldehyde and 1 g. (0.01 mole) of concentrated sulfuric acid were added. The solution was refluxed for four hours on the steam-bath. A light green coloration soon appeared and after forty-five minutes white crystals began to separate. After twenty-four hours in the refrigerator, the crystals were filtered off, washed with alcohol, extracted with boiling alcohol, and recrystallized twice from dioxane.

Summary

1. The synthesis of twenty-one new diphenyl- and triphenylmethane derivatives is reported.
2. Acridines are formed by the cyclization of these compounds.

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