

A Study on the Preparation and Reactions of *p*-N-Benzyl-N-Methyl Amino Benzaldehyde

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p-N-Benzyl-N-methyl amino benzaldehyde was prepared by formylating *p*-N-benzyl-N-methyl aniline using DMF and POCl₃ and its identity established by the preparation of 2 : 4 DNP, Semicarbazone, Oxime, Azine etc. The aldehyde has been condensed with cyanoacetamide, ethyl cyano acetate, malonic acid, rhodanine, thiohydantoin, α -picoline methiodide, α -picoline ethiodide, 1 : 6-dioxojulolidine, 8-methyl-1 : 6-dioxojulolidine and the products isolated and identified. The aldehyde has also been condensed with substituted glycines, and the corresponding 5-(4)-oxazolones obtained. Acid hydrazones were also prepared by condensing the aldehyde with different acid hydrazides.

Preliminary experiments show that the aldehyde can be used as a reagent for the chromatographic detection of acyl glycine and the rhodanine derivative as a reagent for detection of certain metals.

An excellent review has been given by Ferguson¹ on the formylation of aromatic nucleus. Duff and Bills² prepared aromatic hydroxy aldehydes by condensing hexamine and phenols. Later Duff³ extended this method to the formylation of NN-dialkyl anilines. By this method Duff obtained *p*-NN-dialkyl amino or *p*-NN-alkyl aryl amino benzaldehyde in 35-45% yields. This method has been applied successfully to dimethyl, diethyl, methyl ethyl, N-benzyl ethyl, N-benzyl methyl aniline and to dimethyl-*m*-toluidine.

N-Methyl formanilide and dimethyl formamide are very good reagents for introducing the formyl group in an aromatic nucleus. Compaigne and Archer⁴ found dimethyl formamide superior to N-methyl formanilide for the formylation of NN-diethyl aniline. Observations made in this laboratory also confirm this view^{5,6,7}.

2-Methyl-4-NN-dimethyl amino benzaldehyde and N-benzyl-N-ethyl amino benzaldehyde have been prepared in higher yields by Asthana⁸ and (Km.) Veena Gupta⁹ respectively in this laboratory using DMF in comparison to that obtained by Duff³.

Duff³ also formylated N-benzyl-N-methyl aniline in 44% yield by using hexamine, acetic acid, and formic acid. Now the same aldehyde has been prepared using DMF in about 74% yield. The identity of the aldehyde has been established by preparing its 2 : 4 DNP, semicarbazone, oxime and azine.

The aldehyde has now been condensed with active methylene compounds, some heterocyclic bases and substituted dioxo julolidines and the products identified not only by chemical

methods but also by studying their I.R. Spectra. A number of 5(4) oxazolones and hydrazones have also been prepared by condensing the aldehyde with acyl glycines and acid hydrazides respectively.

Some of the possible practical applications of the condensation products are being investigated. The rhodanine derivative gives blood red colour with Ag, brick red colour with Cu and reddish orange colour with Hg even at very high dilution. This observation suggests that the rhodanine derivative of the aldehyde can be used for the qualitative detection of Cu, Ag and Hg by a simple spot test technique on filter strip. Formation of deeply coloured 5(4) oxazolones by the aldehyde can be used in the detection of naturally occurring acyl glycines.

EXPERIMENTAL

Formylation of N-benzyl-N-methyl aniline using dimethyl formamide; formation of p-N-benzyl-N-methyl amino benzaldehyde: To the benzyl methyl aniline (6.7 g., 0.34 mole) placed in a round bottomed flask fitted with a mechanical stirrer and a reflux condenser, was added POCl_3 (5.2 g., 0.34 mole) and dimethyl formamide (8.8 g., 1.2 mole). It was heated with stirring on the steam bath for 3 hrs. This was poured while hot over crushed ice with stirring so as to make a clear solution. After addition of crystalline sodium acetate and keeping overnight, the greenish white solid was collected and further purified by recrystallisation from aqueous ethanol, m.p. 63° , yield, 5.5 g. (74.4%).

2 : 4-DNPH—m.p. 216° (EtOH), found; N, 16.76%; C, 62.7%; H, 4.98%; $\text{C}_{21}\text{H}_{18}\text{N}_5\text{O}_4$ requires N, 17.28%; C, 62.22%; H, 4.69%.

Semicarbazone—m.p. 214° (EtOH), found : N, 19.38%; C, 67.69%; H, 6.54%; $\text{C}_{16}\text{H}_{18}\text{N}_4\text{O}$ requires N, 19.85%; C, 68.08%; H, 6.38%.

Oxime—m.p. 137° (EtOH), found : N, 11.41%; C, 74.8%; H, 6.8%; $\text{C}_{15}\text{H}_{16}\text{N}_2\text{O}$ requires N, 11.66%; C, 75%; H, 6.66%.

Azine—m.p. 196° (EtOH), found : N, 12.4%; C, 80.2%; H, 6.95%; $\text{C}_{30}\text{H}_{30}\text{N}_4$ requires N, 12.55%; C, 80.71%; H, 6.72%.

p-N-Benzyl-N-methyl amino benzylidene cyanoacetamide was prepared by refluxing a mixture of the aldehyde (0.2 g.), cyanoacetamide (0.1 g.), ethanol (5 ml.) and a drop of piperidine gently for 2 hrs. The bright yellow crystalline product which separated on cooling and dilution with water was purified by crystallisation from ethanol, m.p. 176° , yield 0.22 g. (78.5%), found : N, 13.98%; C, 73.69%; H, 5.72%; $\text{C}_{18}\text{H}_{17}\text{N}_3\text{O}$ requires : N, 14.43%; C, 74.26%; H, 5.84%.

p-N-Benzyl-N-methyl amino benzylidene ethyl cyanoacetate was obtained similarly from ethyl cyano acetate, yellow crystals, yield (71%), m.p. 123° (EtOH), found : N, 8.42%; C, 74.3%; H, 6.02%; $\text{C}_{20}\text{H}_{20}\text{N}_2\text{O}_2$ requires N, 8.75%; C, 75%; H, 6.02%.

p-N-Benzyl-N-methyl amino cinnamic acid was prepared by refluxing a mixture of the aldehyde (0.45 g.), malonic acid (0.20 g.), pyridine (0.20 g.) and piperidine (2 drops) over a steam bath for 10 hrs. The yellow oily product thus obtained was extracted with NaHCO_3 solution and the extract acidified with dil. HCl. The precipitated acid was collected and

further purified by recrystallisation from ethanol. Yellow crystals; m.p. 184°. Yield 0.4 g. (75.4%). Found : N, 5.31%; C, 75.92%; H, 6.58%; $C_{17}H_{17}NO_2$ requires N, 5.24%; C, 76.4%; H, 6.36%.

p-N-Benzyl-N-methyl amino benzyldiene rhodanine was prepared by refluxing a mixture of the aldehyde (0.3 g.), rhodanine (0.2 g.) and glacial acetic acid (5 ml.) for 4 hrs. On cooling brownish crystals were formed, further purified by recrystallisation from ethanol, m.p. 227°, yield 0.3 g. (66.6%). Found : N, 7.82%; C, 63.3%; H, 4.62%; $C_{18}H_{16}N_2S_2O$ requires : N, 8.23%; C, 63.52%; H, 4.7%.

p-N-Benzyl-N-methyl amino-β-nitro styrene was prepared by refluxing a mixture of the aldehyde (0.45 g.), nitromethane (0.24 g.) ammonium acetate (0.1 g.) and glacial acetic acid (10 ml.) for 4 hrs in an oil bath maintained at 105°–110°. On cooling orange crystals were separated and these were further purified by recrystallisation from glacial acetic acid, m.p. 180°, yield (75.4%). Found : N, 10.29%; C, 70.12%; H, 6.15%; $C_{16}H_{16}N_2O_2$ requires N, 10.44%; C, 71.64%; H, 5.97%.

p-N-Benzyl-N-methyl amino benzyldiene thiohydantoin was prepared by refluxing a mixture of the aldehyde (0.6 g.), thiohydantoin (0.3 g.), fused sodium acetate (0.25 g.), glacial acetic acid (2 ml.) and a drop of acetic anhydride for 4 hrs. On cooling brownish red crystals were obtained. These were purified by washing with hot ethanol, m.p. 274°, yield (67%). Found : N, 12.52%; C, 66.26%; H, 5.35%; $C_{18}H_{17}N_3OS$ requires N, 13%; C, 66.87%; H, 5.26%.

2-Phenyl-4-(p-N-benzyl-N-methyl amino benzyldiene)-5-oxazolone : The aldehyde (0.2 g.), hippuric acid (0.2 g.), fused sodium acetate (0.08 g.) and acetic anhydride (0.4 ml.) were mixed and heated at 100° for 2 hrs. On cooling an orange coloured crystalline mass was obtained. Bright orange needles were obtained on recrystallisation from ethanol, m.p. 214°, yield 0.15 g. (44.3%). Found : N, 7.16%; C, 77.68%; H, 5.8%; $C_{24}H_{20}N_2O_2$ requires N, 7.6%; C, 78.26%; H, 5.43%.

Using the same experimental conditions and the same molecular proportion of the reactants, the following oxazolones were prepared. Melting point, percentage yield and analytical results are given in Table I.

TABLE I

Name	Formula	m.p. (°C)	Yield %	% of N		% of C		% of H	
				Found	Calc.	Found	Calc.	Found	Calc.
1. 2-Styryl-4-R	$C_{26}H_{22}N_2O_2$	175	55	6.68	7.10	78.69	79.18	5.40	5.58
2. 2-(<i>o</i> -Chlorophenyl)- 4-R	$C_{24}H_{19}N_2O_2Cl$	187	42	6.91	6.95	71.30	71.55	5.10	4.72
3. 2-(<i>p</i> -Chlorophenyl)- 4-R	$C_{24}H_{19}N_2O_2Cl$	191	51	6.70	6.95	70.88	71.55	4.94	4.72
4. 2-(<i>o</i> -Nitrophenyl)- 4-R	$C_{24}H_{19}N_3O_4$	183	39	10.52	10.16	70.20	69.73	5.14	4.60
5. 2-(<i>m</i> -Nitrophenyl) 4-R	$C_{24}H_{19}N_3O_4$	226	57	9.99	10.16	69.32	69.73	4.40	4.60
6. 2-(3 : 5-Dinitrophenyl)- 4-R	$C_{24}H_{18}N_4O_6$	253	47	12.22	12.22	62.64	62.88	3.82	3.93

where R stands for (*p*-N-benzyl-N-methyl amino benzyldiene)-5-oxazolone.

Formation of malon-p-toluidic acid hydrazone of p-N-benzyl-N-methyl amino benzaldehyde :

A mixture of the aldehyde (0.2 g.), malon-*p*-toluidic acid hydrazide (0.2 g.) and ethanol (8 ml.) was refluxed for 2 hrs. The white crystalline hydrazone which separated out was purified by recrystallisation from ethanol, m.p. 193°, yield (69%). Found : N, 13.1%; C, 72.12%; H, 5.92%; $C_{25}H_{26}N_4O_2$ requires N, 13.52%; C, 72.46%; H, 6.28%.

Using the same experimental conditions the following acid hydrazones were prepared. Melting point, percentage yield and analytical results are given in Table 2.

TABLE 2

Name	Formula	m.p. (°C)	Yield %	% of N		% of C		% of H	
				Found	Calc.	Found	Calc.	Found	Calc.
1. Malon- <i>m</i> -toluidic acid-R	$C_{25}H_{26}N_4O_2$	167	66	13.12	13.52	71.98	72.46	5.86	6.28
2. Malon- <i>o</i> -anisidic acid-R	$C_{25}H_{26}N_4O_3$	163	79	12.80	13.02	69.22	69.74	5.72	6.04
3. Malon- <i>m</i> -anisidic acid-R	$C_{25}H_{26}N_4O_3$	170	89	12.76	13.02	69.62	69.74	5.54	6.04
4. Malon- <i>p</i> -anisidic acid-R	$C_{25}H_{26}N_4O_3$	191	92	12.64	13.02	69.26	69.74	6.10	6.04
5. Malon- <i>p</i> -phenetidic acid-R	$C_{26}H_{28}N_4O_3$	182	89	12.52	12.61	70.25	70.27	6.54	6.30
6. Malon- <i>o</i> -phenetidic acid-R	$C_{26}H_{28}N_4O_3$	185	66	12.12	12.61	69.80	70.27	6.02	6.30
7. Malon- <i>o</i> -chloroanilic acid-R	$C_{24}H_{25}N_4O_2Cl$	195	84	12.81	12.88	65.83	66.26	5.56	5.29
8. Isonicotinic acid-R	$C_{21}H_{20}N_4O$	215	82	15.76	16.27	72.84	73.25	5.93	5.89

R = Hydrazone of *p*-N-benzyl-N-methyl amino benzaldehyde.

Formation of 2-(p-N-benzyl-N-methyl amino styryl)-pyridine methiodide : This was prepared by refluxing a mixture of the aldehyde (0.24 g.), α -picoline methiodide (0.24 g.) and two drops of piperidine in absolute ethanol for 4 hrs. On cooling orange crystals separated out. Recrystallised from ethanol, m.p. 233°, yield (52.5%). Found : N, 5.82%; C, 59.2%; H, 4.8%; $C_{22}H_{23}N_2I$ requires N, 6.33%; C, 59.5%; H, 5.2%.

Formation of 2-(p-N-benzyl-N-methyl amino styryl)-pyridine ethiodide : This was obtained similarly from α -picoline ethiodide, blood red shining crystals, m.p. 227° (EtOH), yield (66%). Found : N, 5.68%; C, 59.88%; H, 5.59%; $C_{23}H_{25}N_2I$ requires N, 6.14%; C, 60.52%; H, 5.48%.

Attempts to condense *p*-N-benzyl-N-methylaminobenzaldehyde with γ -picoline methiodide were unsuccessful. No definite product could be isolated.

Formation of 2 : 5-bis-p-N-benzyl-N-methyl amino benzylidene-1 : 6-dioxojulolidine was prepared by refluxing a mixture of the aldehyde (0.2 g.), 1 : 6-dioxojulolidine (0.1 g.) and KOH (0.1 g.) in absolute ethanol (8 ml.) for 2 hrs. Lemon yellow crystals separated out during refluxing. These were recrystallised from acetone. m.p. 161°, yield 0.25 g. (82%).

Found : N, 6.34%; C, 81.32%; H, 6.1%; $C_{42}H_{37}N_3O_2$ requires N, 6.82%; C, 81.95%; H, 6.01%.

Formation of 2 : 5-bis-p-N-benzyl-N-methyl amino benzylidene-8-methyl-1 : 6-dioxojulolidine was prepared similarly from 8-methyl-1 : 6-dioxojulolidine, yellow crystals, m.p. 199° (acetone), yield 89%. Found : N, 6.52%; C, 81.52%; H, 6.62%; $C_{43}H_{39}N_3O_2$ requires : N, 6.67%; C, 82.03%; H, 6.2%.

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