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Synthesis of Some Benzylidenamino Compounds

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Summary. Reactions of 3-substituted-4-amino-4,5-dihydro-1,2,4-triazol-5-ones with salicylaldehyde, *o*-chlorobenzaldehyde and *p*-tolualdehyde were studied, and 14 new benzylidenamino compounds were obtained.

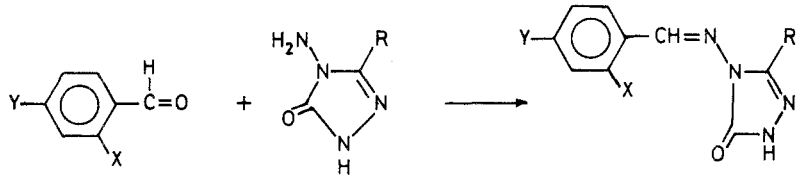
Keywords. 4-Amino-4,5-dihydro-1,2,4-triazol-5-ones; Benzylidenamino compounds; *o*-Chlorobenzaldehyde; Salicylaldehyde; *p*-Tolualdehyde.

Synthesen einiger Benzylidenaminoverbindungen

Zusammenfassung. Die Reaktionen von 3-substituierten 4-Amino-4,5-dihydro-1,2,4-triazol-5-onen mit Salicylaldehyd, *o*-Chlorobenzaldehyd und *p*-Tolualdehyd wurden untersucht und 14 Benzylidenaminoverbindungen dargestellt.

Introduction

In recent years, the reactions of various N-amino-1,2,4-triazoles and N-amino-4,5-dihydro-1,2,4-triazol-5-ones with certain aldehydes and the formation of benzylidenamino compounds have been reported [1–13]. In the present study some 3-alkyl- and 3-aryl-4-amino-4,5-dihydro-1,2,4-triazol-5-ones (**1**) were treated with salicylaldehyde, *o*-chlorobenzaldehyde, and *p*-tolualdehyde (**2**) and the corresponding benzylidenamino derivatives (**3**) were obtained (Scheme 1). Thus, 3-alkyl(aryl)-4-*o*-hydroxybenzylidenamino-, 3-alkyl-4-*o*-chlorobenzylidenamino- and 3-alkyl-(aryl)-4-*p*-methylbenzylidenamino-4,5-dihydro-1,2,4-triazol-5-ones (compounds **3a–3f**, **3g–3j**, and **3k–3n**, respectively) were synthesized (Scheme 1). The group *R*, *X* and *Y* are listed in Table 1.



2
X: H, OH or Cl

1
Y: H or Me

3

Scheme 1

Table 1. List of compounds **3**

No.	*R*	*X*	*Y*
3a	*Me*	OH	H
3b	*Et*	OH	H
3c	*Pr*	OH	H
3d	Isopentyl	OH	H
3e	CH_2Ph	OH	H
3f	*Ph*	OH	H
3g	*Me*	Cl	H
3h	*Et*	Cl	H
3i	*Pr*	Cl	H
3j	CH_2Ph	Cl	H
3k	*Me*	H	*Me*
3l	*Et*	H	*Me*
3m	*Pr*	H	*Me*
3n	*Ph*	H	*Me*

Experimental

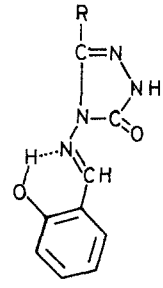
Melting points were determined with a Büchi oil heated melting point apparatus and are uncorrected. The infrared spectra were recorded as potassium bromide pellets using a Perkin-Elmer 377 spectrophotometer. The ^{1}H-NMR and ^{13}C-NMR spectra were obtained on a Varian 60 A spectrometer or a Bruker AC-200 FT instrument.

The starting compounds **1** were synthesized by routes previously reported [8]. The required aldehydes **2** were obtained from Fluka.

General method for the synthesis of **3** type 3-alkyl(aryl)-4-benzylidenamino-4,5-dihydro-1,2,4-triazol-5-one derivatives: 3-Alkyl(aryl)-4-amino-4,5-dihydro-1,2,4-triazol-5-one (**1**) (0.01 mol) was dissolved in 50 ml (or in an appropriate amount) of ethanol (1-pentanol for **3f** and **3n**) and the aldehyde **2** (0.01 mol) was added dropwise with constant shaking. After the addition, the mixture was refluxed for one hour (or 1.5 h) and cooled. The precipitate formed was filtered and dried. Recrystallization of the product from ethanol gave pure compounds **3**.

Results

Data about the reactions and compounds **3** are compiled in Table 2.



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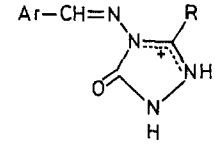

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Table 2. Experimental data for compounds **3**

Compd.	Reaction time (hours)	Yield (%)	M.p. (°C) (crystal-lized from)	Molecular[a] formula (*M*)
3a	1	97	250 (*Et*OH)	$C_{10}H_{10}N_4O_2$ (218.21)
3b	1	91	190 (*Et*OH)	$C_{11}H_{12}N_4O_2$ (232.24)
3c	1	91	179 (*Et*OH)	$C_{12}H_{14}N_4O_2$ (246.26)
3d	1	92	193 (*Et*OH)	$C_{14}H_{18}N_4O_2$ (274.32)
3e	1	96	227 (*Et*OH)	$C_{16}H_{14}N_4O_2$ (294.30)
3f	1	90	230 (*Et*OH)	$C_{15}H_{12}N_4O_2$ (280.28)
3g	1	96	238 (*Et*OH)	$C_{10}H_9ClN_4O$ (236.66)
3h	1	94	208 (*Et*OH)	$C_{11}H_{11}ClN_4O$ (250.69)
3i	1	93	197 (*Et*OH)	$C_{12}H_{13}ClN_4O$ (264.71)
3j	1	97	195 (*Et*OH)	$C_{16}H_{13}ClN_4O$ (312.75)
3k	1.5	95	213 (*Et*OH)	$C_{11}H_{12}N_4O$ (216.24)
3l	1.5	95	163 (*Et*OH)	$C_{12}H_{14}N_4O$ (230.26)
3m	1.5	90	150 (*Et*OH)	$C_{13}H_{16}N_4O$ (244.29)
3n	1.5	96	206 (*Et*OH)	$C_{16}H_{14}N_4O$ (278.30)

[a] All elemental analyses (C, H, N) are in accordance with calculated values

IR, ^{1}H-NMR and ^{13}C-NMR spectral data of compounds **3a–3n** are presented in Tables 3, 4 and 5.

Discussion

As seen from the experimental data – except for **3f** and **3n** – all compounds **3** were obtained in boiling ethanol. The formation of **3f** and **3n** at higher temperatures might be due to the effect of the phenyl group.

Table 3. IR data for compounds **3**

IR (KBr) [cm^{-1}]								
Compd.	ν_{NH}	ν_{OH}	$\nu_{C=O}$	$\nu_{C=N}$	Compd.	ν_{NH}	$\nu_{C=O}$	$\nu_{C=N}$
3a	3180	3060	1700	1590	**3h**	3140	1690	1580
3b	3150	3030	1697	1595	**3i**	3150	1680	1580
3c	3150	3025	1700	1585	**3j**	3160	1693	1580
3d	3157	3040	1695	1580	**3k**	3150	1660	1595
3e	3160	3040	1695	1580	**3l**	3140	1688	1583
3f	3147	3040	1700	1590	**3m**	3150	1690	1580
3g	3155	–	1687	1580	**3n**	3140	1693	1590

Table 4. ^{1}H-NMR data of compounds **3** (δ/ppm in *DMSO-d_6*)

Compd.	CH_3	CH_2	CH_2	N=CH	NH	OH	Aromatic H
3a	2.23 (s)	–	–	10.00 (s)	11.80 (s)	10.30 (s)	7.00 (d, 2H) 7.37 (m, 1H) 7.80 (d, 1H)
3b	1.20 (t)	2.70 (q)	–	9.97 (s)	11.77 (s)	10.27 (s)	6.95 (d, 2H) 7.32 (m, 1H) 7.75 (d, 1H)
3c	0.92 (t)	1.60 (sext)	2.57 (t)	9.95 (s)	11.78 (s)	10.25 (s)	6.95 (d, 2H) 7.31 (m, 1H) 7.76 (d, 1H)
3d	0.90 (d)[a]	1.55 (m)[b]	2.60 (t)	9.87 (s)	11.67 (s)	10.17 (s)	6.97 (d, 2H) 7.34 (m, 1H) 7.75 (d, 1H)
3e	–	–	4.07 (s)	9.88 (s)	11.78 (s)	10.18 (s)	7.00 (d, 2H) 7.40 (m, 6H) 7.78 (d, 1H)
3f	–	–	–	9.85 (s)	12.27 (s)	10.25 (s)	7.00 (d, 2H) 7.35 (m, 1H) 7.40– 8.10 (m, 6H)
3g	2.20 (s)	–	–	10.25 (s)	12.30 (s)	–	7.72 (s, 3H) 8.28 (s, 1H)
3h	1.30 (t)	2.60 (q)	–	10.40 (s)	12.34 (s)	–	7.80 (s, 3H) 8.32 (s, 1H)
3i	1.05 (t)	1.80 (sext)	2.80 (t)	10.50 (s)	12.30 (s)	–	7.80 (s, 3H) 8.30 (s, 1H)
3j	–	–	4.16 (s)	10.40 (s)	12.25 (s)	–	7.50 (m, 5H) 7.70 (s, 3H) 8.20 (s, 1H)

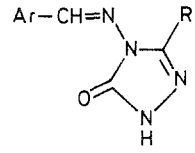
Table 4 (continued)

Compd.	CH_3	CH_2	CH_2	N=CH	NH	OH	Aromatic H
3k	2.33 (t)[c]	–	–	9.70 (s)	11.80 (s)	–	7.30 (d, 2H) 7.70 (d, 2H)
3l	1.26 (t) 2.40 (s)	2.73 (q)	–	9.70 (s)	11.80 (s)	–	7.30 (d, 2H) 7.73 (d, 2H)
3m	0.97 (t) 2.38 (s)	1.67 (sext)	2.67 (t)	9.70 (s)	11.80	–	7.30 (d, 2H) 7.73 (d, 2H)
3n	2.35 (s)	–	–	9.60 (s)	12.60 (s)	–	7.20–8.05 (m, 9H)

[a] 0.90 (d, 6H, $2CH_3$)
[b] 1.55 (m, 3H, CH_2CH)
[c] 2.33 (t, 6H, $2CH_3$)

The ^{1}H-NMR data reveal that the *o*-hydroxybenzylidenamino compounds derived from salicylaldehyde (**3a–3f**) have the phenolimino structure **4**. This chelate formation is in agreement with the data previously reported [14, 15].

Table 5. ^{13}C-NMR data for compounds **3** (δ/ppm in *DMSO-d_6*)



Compd.	Triazole C_3	Triazole C_5	C=N	*R*	*Ar*
3a	144.19	151.09	157.56	11.16	151.29, 132.80, 126.49 119.55, 119.46, 116.43
3b	147.95	151.08	157.56	18.57, 10.01	151.44, 132.78, 126.38 119.61, 119.47, 116.43
3c	146.80	151.03	157.54	26.76, 18.88, 13.47	151.34, 132.80, 126.29, 119.60, 119.48, 116.42
3d	147.12	151.11	157.60	34.49, 27.03 22.88, 22.11	151.37, 132.76, 126.34, 119.62, 119.47, 116.46
3e	146.08	150.90	157.54	135.76, 128.68 (2C) 128.43 (2C), 126.68 31.11	151.27, 132.83, 126.36, 119.55, 119.43, 116.41
3f	144.56	151.36	157.69	129.99, 128.44 (2C) 127.90 (2C), 126.69	153.63, 133.02, 126.59, 119.52, 119.31, 116.45
3g	144.29	151.19	148.71	11.03	134.22, 132.70, 130.95, 130.03, 127.67, 126.80

Table 5 (continued)

Compd.	Triazole C_3	Triazole C_5	C=N	*R*	*Ar*
3h	148.00	151.32	148.75	18.41, 9.96	134.20, 132.69, 130.97, 130.04, 127.70, 126.74
3i	146.90	151.29	148.80	26.62, 18.88, 13.46	134.23, 132.73, 130.98, 130.07, 127.76, 126.74
3j	146.00	151.17	148.69	135.67, 128.72 (2C), 128.42 (2C), 126.70, 30.97	134.10, 132.80, 130.87, 130.06, 127.73, 126.77
3k	144.20	151.27	153.70	11.07	141.41, 130.82, 129.51 (2C), 127.60 (2C), 21.09
3l	147.97	151.43	153.70	18.52, 10.00	141.41, 130.87, 129.52 (2C), 127.56 (2C), 21.07
3m	146.83	151.34	153.69	26.70, 18.87, 13.45	141.42, 130.83, 129.53 (2C), 127.58 (2C), 21.08
3n	144.48	151.37	156.71	129.99, 128.44 (2C), 127.83 (2C), 126.68	141.76, 130.61, 129.61 (2C), 127.81 (2C), 21.09

Table 6. ^{1}H-NMR data in *TFA*

Compd.	δ ppm (in TFA)	Δδ (ppm)	Compd.	δ ppm (in TFA)	Δδ (ppm)
3a	2.50 (s, 3H, CH_3)	0.27	**3e**	4.34 (s, 2H, CH_2)	0.27
3b	1.42 (t, 3H, CH_3) 2.99 (q, 2H, CH_2)	0.22 0.29	**3k**	2.59 (t, 6H, $2CH_3$)	0.26
3c	1.08 (t, 3H, CH_3) 1.82 (sext, 2H, CH_2) 2.87 (t, 2H, CH_2)	0.16 0.22 0.30	**3l**	1.43 (t, 3H, CH_3) 3.00 (q, 2H, CH_2)	0.17 0.27
3d	1.05 (d, 6H, $2CH_3$) 1.75 (m, 3H, CH_2CH) 2.88 (t, 2H, CH_2)	0.15 0.20 0.28	**3m**	1.12 (t, 3H, CH_3) 1.90 (sext, 2H, CH_2) 2.96 (t, 2H, CH_2)	0.15 0.23 0.29

Apart from the measurements given in Table 4, the ^{1}H-NMR measurements of some **3** type compounds were performed in trifluoroacetic acid (see Table 5). Protonation shifts, obtained by comparison of spectra in *DMSO-d_6* and *TFA*, observed for **3** type compounds are consistent with stabilization of the resulting cations **5** in acidic medium by an amidinium type resonance.

Thus, the signals from the groups attached to C-3 were shifted downfield in *TFA*, as seen from Table 6.

In the ^{13}C-NMR spectra of the **3a–3n** series, the aryl ring carbons were assigned by comparing the observed chemical shifts to those calculated by means of substituent parameters [16].

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