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Synthesis of 3-Alkoxy-4-acyloxyphenylmethylene(phenyl)amines

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Abstract— Previously unknown *E* isomers of azomethines (Schiff bases) were synthesized from the vanillin and vanillal esters by the reaction with aniline.

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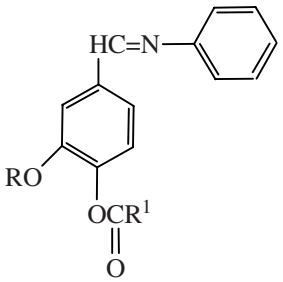
Azomethines derived from natural aldophenols, such as vanillin and vanillal, possess high biologic activity. They also exhibit film-forming properties and are heat and light sensitive. Due to that these compounds can be used for preparing nanomaterials [1, 2]

The aim of the present work is the synthesis of new azomethines based on the vanillin and vanillal esters we obtained previously [3–6]. The reaction of these compounds with aniline in absolute methanol gave (*E*)-3-alkoxy-4-acyloxyphenylmethylene (phenyl)amines **I–XL** containing ether and ester groups in 85–95% isolable yields. According to ^{1}H NMR data, the purity of the products was 98 ± 1%.

Liquid or low-melting vanillin and vanillal esters also readily react with aniline without solvent. By simply mixing stoichiometric amounts of aldehyde and aniline and subsequently heating the mixture to 60–80°C we obtained azomethines **I–IX, XX–XXX, XXXIX, XL** in yields of 99 ± 1%. The purity of the compounds obtained was 92 ± 2%, which is quite enough for preparing azomethine nanofilms by means of thermal vacuum deposition [2]. During this procedure azomethines are additionally purified to no less than 99% purity.

Hence, the condensation in methanol results in slightly decreased yields of target azomethines, but a higher purity of the products is attained. The reaction in solvent-free conditions gives higher yields of azomethines and simplifies their isolation.

Compounds **I–XL** are colorless or slightly colored crystalline compounds having well-defined melting points. Azomethines do not need the additional purification and contain no admixtures of starting compounds. The structure of azomethines **I–XL** was confirmed by the elemental analyses, cryoscopic mole-



I–XL

R = Me, R^1 = Et (**I**), Pr (**II**), Me_2CH (**III**), $Me(CH_2)_6$ (**IV**), $Me(CH_2)_7$ (**V**), $Me(CH_2)_8$ (**VI**), $Me(CH_2)_{16}$ (**VII**), H_2C=CMe (**VIII**), *cyclo*-C_6H_{11} (**IX**), $C_6H_5CH_2$ (**X**), $C_6H_5C(Me)HCH_2$ (**XI**), *Z*-$C_6H_5C(H)$=C(C≡N) (**XII**), C_6H_5 (**XIII**), 4-ClC_6H_4 (**XIV**), 2,4-$Cl_2C_6H_3$ (**XV**), 2,4-$Cl_2C_6H_3OCH_2$ (XVI), 4-BrC_6H_4 (XVII), 3-$O_2NC_6H_4$ (**XVIII**), 3,5-$(O_2N)_2C_6H_3$ (**XIX**), MeO (**XX**), EtO (**XXI**); R = Et, R^1 = Me (**XXII**), Et (**XXIII**), Pr (**XXIV**), Me_2CH (**XXV**), Me_2CHCH_2 (**XXVI**), $Me(CH_2)_4$ (**XXVII**), $Me(CH_2)_8$ (**XXVIII**), $Me(CH_2)_{11}$ (**XXIX**), $Me(CH_2)_{16}$ (**XXX**), *cyclo*-C_6H_{11} (**XXXI**), *trans*-$C_6H_5C(H)$=C(H) (**XXXII**), *Z*-$C_6H_5C(H)$=C(C≡N) (**XXXIII**), 4-MeC_6H_4 (**XXXIV**), 2,4-$Cl_2C_6H_3$ (**XXXV**), 2,4-$Cl_2C_6H_3OCH_2$ (**XXXVI**), 4-$O_2NC_6H_4$ (**XXXVII**), 3,5-$(O_2N)_2C_6H_3$ (**XXXVIII**), MeO (**XXXIX**), EtO (**XL**).

Yields, melting points, elemental analyses, and molecular weights of azomethines **I–XL**

Comp. no.	Yield, %	mp, °C	Found, %			Formula	Calculated, %			*M*	
			C	H	N		C	H	N	found	calculated
I	88	43–44	72.39	6.14	4.78	$C_{17}H_{17}NO_3$	72.07	6.05	4.94	275.6	283.3
II	90	21–22	73.06	6.59	4.50	$C_{18}H_{19}NO_3$	72.71	6.44	4.71	285.8	297.4
III	92	47–48	72.96	6.49	4.52	$C_{18}H_{19}NO_3$	72.71	6.44	4.71	289.1	297.4
IV	94	25–26	74.88	7.78	3.83	$C_{22}H_{27}NO_3$	74.76	7.70	3.96	340.7	353.5
V	91	20–21	75.35	8.08	3.62	$C_{23}H_{29}NO_3$	75.17	7.95	3.81	354.2	367.5
VI	95	20–21	75.80	8.31	3.60	$C_{24}H_{31}NO_3$	75.56	8.19	3.67	365.0	381.5
VII	90	63–64	78.03	9.70	2.57	$C_{32}H_{47}NO_3$	77.85	9.59	2.84	480.6	493.7
VIII	85	62–63	73.37	5.83	4.61	$C_{18}H_{17}NO_3$	73.20	5.80	4.74	278.4	295.3
IX	89	96–97	74.95	7.00	3.97	$C_{21}H_{23}NO_3$	74.75	6.87	4.15	328.3	337.4
X	90	50–51	76.84	5.62	3.83	$C_{22}H_{19}NO_3$	76.50	5.54	4.06	337.3	345.4
XI	91	47–48	77.53	6.43	3.48	$C_{24}H_{23}NO_3$	77.19	6.21	3.75	358.9	373.5
XII	88	182–183	75.65	4.97	7.06	$C_{24}H_{18}N_2O_3$	75.38	4.74	7.33	365.8	382.4
XIII	95	108–109	76.39	5.29	3.95	$C_{21}H_{17}NO_3$	76.12	5.17	4.23	322.5	331.4
XIV[a]	92	127–128	69.20	4.56	3.54	$C_{21}H_{16}ClNO_3$	68.95	4.41	3.83	351.4	365.8
XV[b]	93	105–106	63.29	3.98	3.25	$C_{21}H_{15}Cl_2NO_3$	63.02	3.78	3.50	386.3	400.3
XVI[c]	88	122–123	61.78	4.12	2.90	$C_{22}H_{17}Cl_2NO_4$	61.41	3.98	3.26	418.7	430.3
XVII[d]	94	132–133	61.48	3.93	3.41	$C_{21}H_{16}BrNO_3$	61.48	3.93	3.41	402.6	410.3
XVIII	93	128–129	67.15	4.35	7.14	$C_{21}H_{16}N_2O_5$	67.02	4.28	7.44	365.1	376.4
XIX	95	192–193	60.01	3.68	9.52	$C_{21}H_{15}N_3O_7$	59.86	3.59	9.97	408.8	421.4
XX	88	76–77	67.77	5.36	4.70	$C_{16}H_{15}NO_4$	67.36	5.30	4.91	272.4	285.3
XXI	86	48–49	68.38	5.80	4.47	$C_{17}H_{17}NO_4$	68.22	5.72	4.68	289.6	299.3
XXII	90	37–38	72.34	6.05	4.80	$C_{17}H_{17}NO_3$	72.07	6.05	4.94	275.0	283.3
XXIII	85	71–72	72.99	6.48	4.47	$C_{18}H_{19}NO_3$	72.71	6.44	4.71	290.4	297.4
XXIV	87	16–17	73.56	6.90	4.18	$C_{19}H_{21}NO_3$	73.29	6.80	4.50	303.7	311.4
XXV	88	63–64	73.54	6.92	4.24	$C_{19}H_{21}NO_3$	73.29	6.80	4.50	304.2	311.4
XXVI	91	72–73	74.05	7.22	4.05	$C_{20}H_{23}NO_3$	73.82	7.12	4.30	316.4	325.4
XXVII	90	28–29	74.50	7.52	3.91	$C_{21}H_{25}NO_3$	74.31	7.42	4.13	330.1	339.4
XXVIII	93	27–28	76.19	8.45	3.32	$C_{25}H_{33}NO_3$	75.92	8.41	3.54	381.5	395.5
XXIX	92	57–58	76.98	9.03	2.96	$C_{28}H_{39}NO_3$	76.85	8.98	3.20	428.7	437.6
XXX	89	56–57	78.34	9.76	2.65	$C_{33}H_{49}NO_3$	78.06	9.73	2.76	489.8	507.8
XXXI	90	76–77	75.43	7.28	3.80	$C_{22}H_{25}NO_3$	75.19	7.17	3.99	340.9	351.4
XXXII	92	110–111	77.85	5.79	3.63	$C_{24}H_{21}NO_3$	77.61	5.70	3.77	362.0	371.4
XXXIII	91	152–153	76.03	5.19	6.84	$C_{25}H_{20}N_2O_3$	75.74	5.08	7.07	380.3	396.4
XXXIV	89	113–114	77.00	5.90	3.79	$C_{23}H_{21}NO_3$	76.86	5.89	3.90	350.2	359.4
XXXV[e]	93	118–119	64.04	4.21	3.07	$C_{22}H_{17}Cl_2NO_3$	63.78	4.14	3.38	401.4	414.3
XXXVI[f]	90	113–114	62.29	4.52	2.88	$C_{23}H_{19}Cl_2NO_4$	62.18	4.31	3.15	428.6	444.3
XXXVII	91	131–132	67.87	4.78	6.87	$C_{22}H_{16}N_2O_5$	67.69	4.65	7.18	376.7	390.4
XXXVIII	89	187–188	60.94	4.10	9.36	$C_{22}H_{17}N_3O_7$	60.69	3.94	9.65	421.9	435.4
XXXIX	85	37–38	68.47	5.83	4.32	$C_{17}H_{17}NO_4$	68.22	5.72	4.68	291.5	299.3
XL	90	101–102	69.35	6.18	4.14	$C_{18}H_{19}NO_4$	69.00	6.11	4.47	302.8	313.4

[a] Found Cl, %: 9.45. Calculated Cl, %: 9.69. [b] Found Cl, %: 17.48. Calculated Cl, %: 17.71. [c] Found Cl, %: 16.20. Calculated Cl, %: 16.48. [d] Found Br, %: 19.09. Calculated Br, %: 19.48. [e] Found Cl, %: 16.92. Calculated Cl, %: 17.12. [f] Found Cl, %: 15.70. Calculated Cl, %: 15.96.

cular weights (see table), and IR, UV, and ^{1}H NMR spectra.

The IR spectra of azomethines **I–XL** contain absorption bands of C–H_{Ar} (3100–3000 and 780–680 cm^{-1}), C–H_{Alk} (2990–2830 cm^{-1}), C=O (1770=1740 cm^{-1}), C=N (1630–1627 cm^{-1}), C–C_{Ar} (1600 and 1315 cm^{-1}), and C–O bonds (1280 and 1035 cm^{-1}). The presence of NO_2 groups in compounds **XVIII, XIX**, **XXXVII**, and **XXXVIII** is confirmed by the observation of

characteristic bands at 1541–1525 and 1349–1343 cm^{-1}. The IR spectra of compounds **XII, XXXIII** show a characteristic C≡N absorption band at 2225–2224 cm^{-1}.

The UV spectra of compounds **I–XL** contain the following absorption bands, λ_{max}, nm (log ε): 202 (4.52), 221 (4.36), 269 (4.18), and 316 (4.08). These bands belong to the (*E*)-3-alkoxy-4-acyloxyphenylmethylene(phenyl)amine fragments.

The ^1H NMR spectra of azomethines **I–XXI** show MeO singlets at δ 3.85–3.92 ppm. The EtO proton signals of compounds **XXII–XL** appear as a triplet at 1.40–1.70 ppm (Me) and a quartet at 4.00–4.50 ppm (CH_2). The aromatic proton signals of azomethines **I–XL** are located at δ 7.05–7.75 ppm. The HC=N proton signals are singlets at δ 8.35–8.47 ppm, which is characteristic of the *E* isomers of azomethines [1, 2, 7–9].

The IR, UV, and ^1H spectra of azomethines **I–IX** provide evidence for the presence of the corresponding ester structural fragments [1–9].

To confirm the assigned *E* configuration of the synthesized azomethines, we carried out quantum-chemical calculations of the heats of formation (H_f) of the *E* and *Z* isomers of compounds **I, XIII**, **XXII**, and **XXXIV** by the semiempirical MNDO PM3 method using the GAMESS program [10]. Full optimization of all interatomic distances and bond and dihedral angles was performed. The following H_f values (kcal mol^{-1}) were obtained for the *E* isomers (the H_f for the *Z* isomers are given in brackets): –53.1 (–52.1) (**I**), –11.6 (–10.9) (**XIII**), –53.5 (–53.3) (**XXII**), –28.2 (–27.4) (**XXXIV**). The calculations showed that the *E* configuration is 0.2–1.0 kcal mol^{-1} more favorable than *Z*. These results are nicely consistent with published data for related compounds [7–9].

EXPERIMENTAL

The IR spectra were recorded on a Nicolet Protege-460 FTIR spectrometer in KBr pellets. The UV spectra were registered on a Varian UV-Vis Cary-300 spectrophotometer for 1×10^{-4} M methanol solutions. The ^1H NMR spectra were taken on a Tesla BS-587A (100 MHz) spectrometer for 5% $CDCl_3$ solutions against internal TMS. The elemental analyses were obtained on an Elementar Vario EL-III C, H, N, O, S analyzer, determination error 0.1%. The molecular weights (*M*) were evaluated cryoscopically in benzene.

The vanillin and vanillal esters were synthesized according to the procedures in [3–6].

(*E*)-3-Alkoxy-4-acyloxyphenylmethylene(phenyl)-amines I–XL. A solution of 5 mmol of vanillin or vanillal ester and 5 mmol of aniline in 30 ml of absolute methanol was refluxed for 15 min. The solution was filtered while hot through a folded paper filter, cooled, and left for 10–15 h at 5°C. Crystals of compounds **I–XL** formed and were filtered off on a glass frit, washed with a little methanol, and dried in air at 20–23°C for 1 day (see table).

(*E*)-3-Alkoxy-4-acyloxyphenylmethylene(phenyl)-amines I–IX, XX–XXX, XXXIX, XL. A mixture of 5 mmol of vanillin or vanillal ester and 5 mmol of aniline was heated carefully at 60–80°C in a ceramic crucible for 20–30 min. The homogenous mold that formed crystallized on cooling, and the product was dried in air at 20–23°C for 3–5 days.

REFERENCES

1. Dikusar, E.A., Kozlov,N.G., Tlegenov, R.T., and Uteniyazov, K.U., *Azometiny na osnove vanilina i vanilalya* (The Vanillin- and Vanillal-based Azomethines), Nukus: Karakalpakstan, 2007.
2. Dikusar, E.A., Kozlov, N.G., Potkin, V.I., Azarko, V.A., and Yuvchenko, A.P., *Zh. Obshch. Khim.*, 2007, vol. 77, no. 2, p. 306.
3. Dikusar, E.A., Vyglazov, O.G., Moiseichuk, K.L., Zhukovskaya, N.A., and Kozlov, N.G., *Zh. Prikl. Khim.,* 2005, vol. 78, no. 1, p. 122.
4. Dikusar E.A., Kozlov N.G., *Khim. Prirodn. Soedin.,* 2005, no. 1, p. 74.
5. Dikusar, E.A. and Kozlov, N.G., *Zh. Org. Khim.,* 2005, vol. 41, no. 7, p. 1015.
6. Dikusar, E.A., *Zh. Prikl. Khim*., 2006, vol. 79, no. 6, p. 1043.
7. Dikusar, E.A., Kozlov, N.G., Potkin, V.I., Zelenovskii, V.M., Malama, A.A., and Dubovik, S.V., *Khim. Prirodn. Soedin*., 2005, no. 2, p. 164.
8. Dikusar, E.A., Kozlov, N.G., Potkin, V.I., and Zelenkovskii ,V.M., *Zh. Obshch. Khim*., 2006, vol. 76, no. 1, p. 87
9. Dikusar, E.A., Kozlov, N.G., Zhukovskaya, N.A., Potkin, V.I., Ogorodnikova, M.M., and Zelenkovskii, V.M., *Zh. Org. Khim*., 2006, vol. 42, no. 2, p. 223.
10. Schmidt, M.V., Baldridge, K.K., Boatz, J.A., Elbert, S.T., Gordon, M.S., Jensen, J.H., Koseki, S., Matsunaga, N., Nguyen, K.A., Su, S.J., Midus, T.L., Dupnis, M., and Montgomery, J.A., *J. Comput. Chem.,* 1993, vol. 14, no. 7, p. 1347