ISSN 1070-4280, Russian Journal of Organic Chemistry, 2011, Vol. 47, No. 8, pp. 1204–1208. © Pleiades Publishing, Ltd., 2011.
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Synthesis of 2-Substituted Aminothiazol-4(5*H*)-ones Proceeding from Carboxylactones

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Received October 27, 2010

Abstract—New representatives of 2,2,4-trisubstituted butano-4-lactones were synthesized. By a series of transformations the corresponding γ-carboxylactones were obtained. The latter served as starting compounds for preparation of heteryl-linked lactones, 5-[5-{(alkoxymethyl)-2-oxotetrahydrofuran-3-yl}methyl]-2-arylamino-thiazol-4(5*H*)-ones.

DOI: 10.1134/S1070428011080148

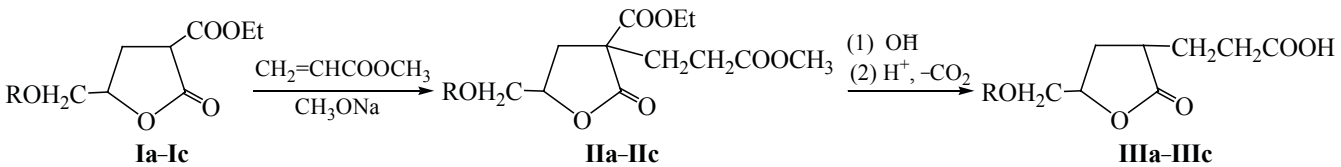
Carboxylactones are known to be successfully used in the synthesis of compounds of various classes. In particular, some carboxylactone esters are used as additives to rocket propellants [1], in the synthesis of oxazolines [2], prostaglandins derivatives [3], and triazolyllactones [4–8] exhibiting hypotensive and antitumor action.

The aim of this study was the extension of the choice of carboxylactones, the development of the procedures for the preparation therefrom of new heterocyclic compounds, and the investigation of the useful practical properties of the latter. To fulfill this goal we selected as initial compounds ethyl 5-alkoxymethyl-2-oxotetrahydrofuran-3-carboxylates **Ia–Ic**, being good CH-acids. We carried out the condensation of compounds **Ia–Ic** with methyl acrylate in the conditions of Michael reaction. As a result we obtained in high yields ethyl 5-(alkoxymethyl)-3-(3-methoxy-3-oxopropyl)-2-oxotetrahydrofuran-3-carboxylates **IIa–IIc** which by the alkaline hydrolysis were converted into 3-[5-(alkoxymethyl)-2-oxotetrahydrofuran-3-yl]-propionic acids **IIIa–IIIc** (Scheme 1).

The best results were obtained in the condensation catalyzed with sodium methylate followed by the hydrolysis with 30% solution of NaOH.

Taking into consideration that the halo-substituted γ-lactones are successfully used for preparation of compounds of various classes [9, 10], analogs of natural substances [11, 12], carboxylactones **IIIa–IIIc** were converted into the corresponding acyl chlorides **IVa–IVc** by the treatment with thionyl chloride in the presence of catalytic quantity of DMF (Scheme 2). Further the bromination of compounds **IVa–IVc** and the subsequent reaction of the obtained chlorides of α-bromoacids with anhydrous ethanol afforded in a high yield ethyl 2-bromo-3-(5-alkoxymethyl 2-oxotetrahydrofuran-3-yl) propanoates **Va–Vc** (Scheme 2).

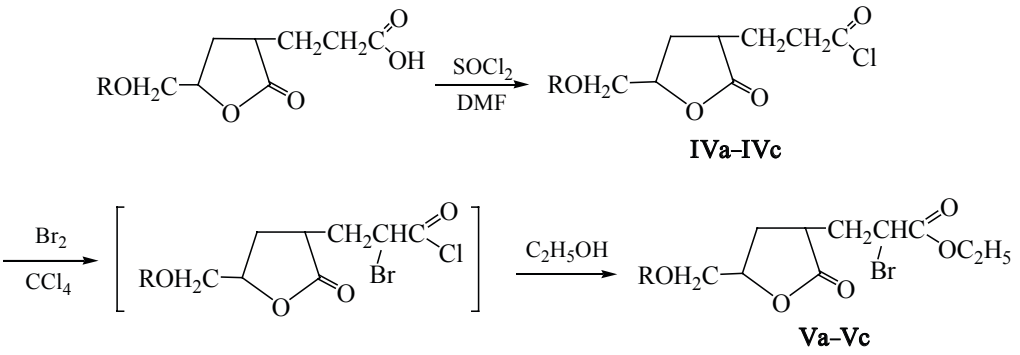
Scheme 1.



Ia–Ic **IIa–IIc** **IIIa–IIIc**

R = C_2H_5 (**a**), *iso*-C_3H_7 (**b**), C_5H_{11} (**c**).

Scheme 2.



R = C_2H_5 (**a**), *iso*-C_3H_7 (**b**), C_5H_{11} (**c**).

The bromination is favorably performed in anhydrous CCl_4 at 60–65°C.

In order to obtain new heteryl-linked γ-lactones we studied the reaction of compounds **Va–Vc** with arylthioureas. As a result of the substitution followed by heterocyclization we obtained in good yields hydrobromides of 2-arylamino derivatives of thiazol-4(5*H*)-ones whose treating with aqueous ammonia gave the corresponding free bases **VIa–VIh** (Scheme 3).

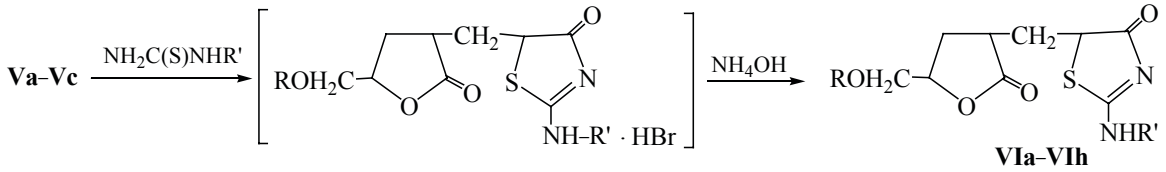
The analysis of the spectral characteristics of the reaction products showed that in the solution aryl-substituted derivatives **VI** exist in a tautomeric equilibrium with imine form **VII** (Scheme 4).

The electronic character of substituent R' in the aromatic ring affects the ratio of the tautomers. According to ^{1}H NMR data in the case of electron-donor substituents the ratio (**VI**):(**VII**) is 90 : 10, and in the case of electron-acceptor substituents, 60 : 40.

EXPERIMENTAL

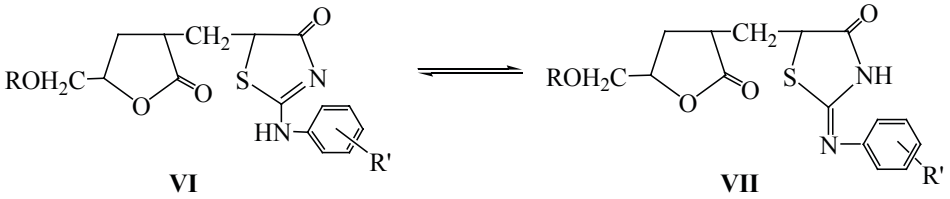
^{1}H NMR spectra were registered on a spectrometer Varian Mercury-300 (300 MHz), solvent $CDCl_3$, internal reference TMS. IR spectra were recorded on a spectrophotometer Nicolet FTIR Nexus from liquid films or mulls in mineral oil. TLC was carried out on Silufol UV-254 plates, eluents ethanol–benzene–hexane, 3 : 3 : 10 v/v (A), ethanol–benzene, 1 : 5 v/v (B); development in iodine vapor. Melting points were measured on a Boëtius heating block.

Scheme 3.



R = C_2H_5, R' = *p*-$CH_3C_6H_4$ (**a**), *p*-$C_2H_5OC_6H_4$ (**b**); R = *iso*-C_3H_7, R' = *p*-$CH_3C_6H_4$ (**c**), *p*-$C_2H_5OC_6H_4$ (**d**), C_6H_5 (**e**); R = C_5H_{11}, R' = *p*-$CH_3C_6H_4$ (**f**), *p*-$C_2H_5OC_6H_4$ (**g**), C_6H_5 (**h**).

Scheme 4.



Initial ethyl 5-(alkoxymethyl)-2-oxotetrahydrofuran-3-carboxylates **Ia–Ic** were prepared by method [13].

Ethyl 5-(alkoxymethyl)-3-(3-methoxy-3-oxopropyl)-2-oxotetrahydrofuran-3-carboxylates IIa–IIc. General procedure. A mixture of 0.1 mol of ethyl 5-(alkoxymethyl)-2-oxotetrahydrofuran-3-carboxylate **Ia–Ic** and 0.105 mol of methyl acrylate was heated to 45°C, and a solution of sodium methylate obtained by dissolving 0.2 g of metallic sodium in 20 ml of anhydrous methanol was added dropwise maintaining the temperature at 45–50°C. The mixture was stirred for 4 h at 20–25°C, then it was acidified by dilute hydrochloric acid to pH 2–3. The product was extracted into ethyl ether, the extract was washed with water, dried with $MgSO_4$, the solvent was distilled off, and the residue was purified by distillation.

Ethyl 5-(ethoxymethyl)-3-(3-methoxy-3-oxopropyl)-2-oxotetrahydrofuran-3-carboxylate (IIa). Yield 82%, bp 159°C (2 mm Hg), R_f 0.47 (A), n_D^{20} 1.4585, d_4^{20} 1.1664. Found, %: C 55.40; H 7.00. $C_{14}H_{22}O_7$. Calculated, %: C 55.63; H 7.28.

Ethyl 5-(isopropoxymethyl)-3-(3-methoxy-3-oxopropyl)-2-oxotetrahydrofuran-3-carboxylate (IIb). Yield 88%, bp 165–166°C (2 mm Hg), R_f 0.49 (A), n_D^{20} 1.4578, d_4^{20} 1.1430. Found, %: C 57.00; H 7.69. $C_{15}H_{24}O_7$. Calculated, %: C 56.96; H 7.59.

Ethyl 5-(pentoxymethyl)-3-(3-methoxy-3-oxopropyl)-2-oxotetrahydrofuran-3-carboxylate (IIc). Yield 89%, bp 170–171°C (1 mm Hg), R_f 0.50 (A), n_D^{20} 1.4572, d_4^{20} 1.0967. Found, %: C 59.00; H 8.40. $C_{17}H_{28}O_7$. Calculated, %: C 59.30; H 8.14.

3-[5-(Alkoxymethyl)-2-oxotetrahydrofuran-3-yl] propionic acids IIIa–IIIc. General procedure. To a mixture of 11.2 g (0.28 mol) of 30% solution of sodium hydroxide and 0.8 ml of catamine AB at room temperature was slowly added 0.08 mol of compound **IIa–IIc**, the mixture was stirred for 2 h, and then for 4 h more at 65–70°C. The mixture was cooled and acidified with concn. HCl till pH 1–2. The product was extracted into ethyl ether, the extract was washed with water, dried with $MgSO_4$, the solvent was distilled off, the residue was subjected to decarboxylation at 250–300°C at the pressure of 15–20 mm Hg within 30 min, and the product was distilled.

3-[5-(Ethoxymethyl)-2-oxotetrahydrofuran-3-yl] propionic acid (IIIa). Yield 77%, bp 176°C (1 mm Hg), n_D^{20} 1.4695, d_4^{20} 1.1740. Found, %: C 55.00; H 7.69. $C_{10}H_{16}O_5$. Calculated, %: C 55.56; H 7.401.

3-[5-(Isopropoxymethyl)-2-oxotetrahydrofuran-3-yl]propionic acid (IIIb). Yield 76%, bp 159°C (1 mm Hg), n_D^{20} 1.4667, d_4^{20} 1.1300. Found, %: C 57.50; H 7.69. $C_{11}H_{18}O_5$. Calculated, %: C 57.39; H 7.83.

3-[5-(Pentoxymethyl)-2-oxotetrahydrofuran-3-yl] propionic acid (IIIc). Yield 83%, bp 192–193°C (1 mm Hg), n_D^{20} 1.4670, d_4^{20} 1.0981. Found, %: C 60.35; H 8.65. $C_{13}H_{22}O_5$. Calculated, %: C 60.47; H 8.53.

3-[5-(Alkoxymethyl)-2-oxotetrahydrofuran-3-yl] propionyl chlorides IVa–IVc. General procedure. A mixture of 0.05 mol of compound **IIIa–IIIc** in 55 ml of anhydrous benzene, 0.5 ml of DMF, and 0.055 mol of thionyl chloride was kept at room temperature for 1 h, then it was boiled for 4 h. The solvent was removed in a vacuum, the residue was purified by distillation

3-[5-(Ethoxymethyl)-2-oxotetrahydrofuran-3-yl]propionyl chloride (IVa). Yield 76%, bp 165°C (3 mm Hg), n_D^{20} 1.4670, d_4^{20} 1.1778. Found, %: C 51.17; H 6.65; Cl 15.50. $C_{10}H_{15}O_4Cl$. Calculated, %: C 51.17; H 6.39; Cl 15.14.

3-[5-(Isopropoxymethyl)-2-oxotetrahydrofuran-3-yl]propionyl chloride (IVb). Yield 70%, bp 156°C (1 mm Hg), n_D^{20} 1.4660, d_4^{20} 1.1463. Found, %: C 53.00; H 6.90; Cl 14.70. $C_{11}H_{17}O_4Cl$. Calculated, %: C 53.12; H 6.84; Cl 14.29.

3-[5-(Pentoxymethyl)-2-oxotetrahydrofuran-3-yl] propionyl chloride (IVc). Yield 78%, bp 173°C (1 mm Hg), n_D^{20} 1.4640, d_4^{20} 1.1055. Found, %: C 56.30; H 7.70; Cl 13.00. $C_{13}H_{21}O_4Cl$. Calculated, %: C 56.42; H 7.59; Cl 12.84.

Ethyl 2-bromo-3-[5-(alkoxymethyl)-2-oxotetrahydrofuran-3-yl]propionate Va–Vc. General procedure. A solution of 0.036 mol of compound **IVa–IVc** in 30 ml of anhydrous CCl_4 was heated at 60°C, and to it was added dropwise a solution of 0.036 mol of bromine in 10 ml of CCl_4. After the addition of all bromine the mixture was boiled for 2 h, cooled, and 20 ml of anhydrous ethanol was added, the mixture was boiled for 3 h, the solvent was removed, the residue was distilled.

IR spectra of compounds **Va–Vc**, ν, cm^{-1}: 1770 ($C{=}O_{lactone}$), 1735 ($C{=}O_{ester}$), 1125, 1180, 1280 (C–O–C), 680 (C–Br).

Ethyl 2-bromo-3-[5-(ethoxymethyl)-2-oxotetrahydrofuran-3-yl]propionate (Va). Yield 73%, bp 172–175°C (1 mm Hg), R_f 0.53 (A), n_D^{20} 1.4695, d_4^{20} 1.1764. Found, %: C 44.40; H 6.00; Br 25.00. $C_{12}H_{19}O_5Br$. Calculated, %: C 44.58; H 5.88; Br 24.77.

Ethyl 2-bromo-3-[5-(isopropoxymethyl)-2-oxotetrahydrofuran-3-yl]propionate (Vb). Yield 65%, bp 174°C (1 mm Hg), R_f 0.55 (A), n_D^{20} 1.4675, d_4^{20} 1.1300. Found, %: C 46.50; H 6.00; Br 24.00. $C_{13}H_{21}O_5Br$. Calculated, %: C 46.29; H 6.23; Br 23.74.

Ethyl 2-bromo-3-[5-(pentoxymethyl)-2-oxotetrahydrofuran-3-yl]propionate (Vc). Yield 70%, bp 178°C (1 mm Hg), R_f 0.46 (A), n_D^{20} 1.4685, d_4^{20} 1.1420. Found, %: C 49.50; H 6.80; Br 22.00. $C_{15}H_{25}O_5Br$. Calculated, %: C 49.31; H 6.85; Br 21.92.

5-{5-[(Alkoxymethyl)-2-oxotetrahydrofuran-3-yl]methyl}-2-arylaminothiazol-4(5*H*)-ones VIa–VIh. **General procedure.** To a mixture of 0.006 mol of thiourea derivative in 5 ml of anhydrous acetone was added dropwise a solution of 0.006 mol of compound **Va–Vc** in 5 ml of acetone, the mixture was stirred for 1 h at room temperature and was boiled for 1 h. On removing acetone water was added, and next aqueous ammonia was added till pH 7, the precipitate was separated, dried, and recrystallized from aqueous ethanol.

5-{5-[(Ethoxymethyl)-2-oxotetrahydrofuran-3-yl]methyl}-2-*p*-tolylaminothiazol-4(5*H*)-one (VIa). Yield 65%, mp 98–100°C (water–ethanol, 3 : 2), R_f 0.55 (B). IR spectrum, ν, cm^{-1}: 3250, 3190 (NH), 3080 (=CH), 1755 (C=O$_{lactone}$), 1675 (C=O$_{cyclic\ amide}$), 1610 (C=C$_{arom}$), 1560 (C=N), 1180, 1120 (C–O–C). ^{1}H NMR spectrum, δ, ppm: 1.11–1.29 m (3H, $\underline{CH_3}CH_2$), 1.59–2.33 m (4H, $CH\underline{CH_2}CH\underline{CH_2}$), 2.33 s (3H, CH_3-Ar), 3.40–3.66 m (4H, CH_2OCH_2), 4.02–4.14 m, 4.21 t.t, 4.44–4.54 m (1H, CH in furanone, *J* 10.3, *J* 4.8 Hz), 4.34–4.44 m, 4.55–4.68 m (1H, CHO in furanone), 6.89 d.d (1H, CH в thiazolidone, *J* 8.3, *J* 3.6 Hz), 7.10, 7.27, 7.61 d (1H$_{arom}$, *J* 7.9, *J* 8.7, *J* 7.9 Hz), 10.86 s and 11.58 br.s (1H, NH). Found, %: C 59.12; H 6.00; N 8.00; S 8.50. $C_{18}H_{22}N_2O_4S$. Calculated, %: C 59.67; H 6.12; N 7.73; S 8.85.

5-{5-[(Ethoxymethyl)-2-oxotetrahydrofuran-3-yl]methyl}-2-*p*-ethoxyphenylaminothiazol-4(5*H*)-one (VIb). Yield 80%, mp 142–143°C (water–ethanol, 1 : 2), R_f 0.57 (B). IR spectrum, ν, cm^{-1}: 3250, 3190 (NH), 3080 (=CH), 1755 (C=O$_{lactone}$), 1670 (C=O$_{cyclic\ amide}$), 1605 (C=C$_{arom}$), 1550 (C=N), 1200, 1140 (C–O–C). ^{1}H NMR spectrum, δ, ppm: 1.07–1.28 m (3H, $\underline{CH_3}CH_2$), 1.40 t (3H, $\underline{CH_3}CH_2$O-Ar, *J* 6.07 Hz), 1.60–2.47 m (4H, $CH\underline{CH_2}CH\underline{CH_2}$), 3.44–3.63 m (4H, CH_2OCH_2), 4.01 q (2H, $CH_3\underline{CH_2}$O-Ar, *J* 7.1 Hz), 4.14–4.44 m (1H, CH in furanone), 4.44–4.68 m (1H, CHO in furanone), 6.88 d.d (1H, CH in thiazolidone, *J* 8.3, *J* 3.6 Hz), 6.82 d (2H$_{arom}$, *J* 8.7 Hz), 6.91–7.01 m (1H$_{arom}$), 7.62 d (1H$_{arom}$, *J* 8.7 Hz), 10.81 d (1H, NH, *J* 6.3 Hz). Found, %: C 59.00; H 6.20; N 7.54; S 8.02. $C_{19}H_{24}N_2O_5S$. Calculated, %: C 58.15; H 6.16; N 7.14; S 8.18.

5-{5-[(Isopropoxymethyl)-2-oxotetrahydrofuran-3-yl]methyl}-2-*p*-tolylaminothiazol-4(5*H*)-one (VIc). Yield 70%, mp 128–129°C (water–ethanol, 1 : 2), R_f 0.58 (B). IR spectrum, ν, cm^{-1}: 3300, 3180 (NH), 3050 (=CH), 1765 (C=O$_{lactone}$), 1675 (C=O$_{cyclic\ amide}$), 1610 (C=C$_{arom}$), 1565 (C= N), 1190, 1110 (C–O–C). ^{1}H NMR spectrum, δ, ppm: 1.00–1.28 m [6H, $(\underline{CH_3})_2CH$], 1.99–2.29 m (4H, $CH\underline{CH_2}CH\underline{CH_2}$), 2.32 s (3H, CH_3-Ar), 3.37–3.72 m (3H, $CHOCH_2$), 3.99–5.15 m (2H, CH in furanone), 6.94 d (1H, CH in thiazolidone, *J* 7.1 Hz), 7.04–7.16 m (2H$_{arom}$), 7.27 d (2H$_{arom}$, *J* 8.7 Hz), 10.85 d, 11.60 br.s (1H, NH, *J* 4.8 Hz). Found, %: C 60.80; H 6.50; N 7.50; S 8.00. $C_{19}H_{24}N_2O_4S$. Calculated, %: C 60.64; H 6.38; N 7.45; S 8.51.

5-{5-[(Isopropoxymethyl)-2-oxotetrahydrofuran-3-yl]methyl}-2-*p*-ethoxyphenylaminothiazol-4(5*H*)-one (VId). Yield 80%, mp 130–131°C (water–ethanol, 1 : 2), R_f 0.60 (B). IR spectrum, ν, cm^{-1}: 3250, 3190 (NH), 3050 (=CH), 1755 (C=O$_{lactone}$), 1670 (C=O$_{cyclic\ amide}$), 1610 (C=C$_{arom}$), 1555 (C=N), 1180, 1120 (C–O–C). ^{1}H NMR spectrum, δ, ppm: 0.70–1.35 m [6H, $(\underline{CH_3})_2CH$], 1.40 t (3H, $\underline{CH_3}CH_2$O-Ar, *J* 6.7 Hz), 1.54–2.47 m (4H, $CH\underline{CH_2}CH\underline{CH_2}$), 2.57 and 3.38–3.71 m (3H, $CHOCH_2$), 4.01 q (2H, $CH_3\underline{CH_2}$O, *J* 6.9 Hz), 4.10–5.23 m (2H, CH in furanone), 6.80 m (1H, CH in thiazolidone), 6.82 d (2H$_{arom}$, *J* 8.7 Hz), 6.89–7.08 m (1H$_{arom}$), 7.63 d (1H$_{arom}$, *J* 8.7 Hz), 10.80 and 11.53 br.s (1H, NH). Found, %: C 59.00; H 6.30; N 7.00; S 7.50. $C_{20}H_{26}N_2O_5S$. Calculated, %: C 59.11; H 6.40; N 6.89; S 7.90.

5-{5-[(Isopropoxymethyl)-2-oxotetrahydrofuran-3-yl]methyl}-2-phenylthiazol-4(5*H*)-one (VIe). Yield 75%, mp 140–141°C (water–ethanol, 1 : 2), R_f 0.54 (B). IR spectrum, ν, cm^{-1}: 3250, 3190 (NH), 3080 (=CH), 1755 (C=O$_{lactone}$), 1675 (C=O$_{cyclic\ amide}$), 1610 (C=C$_{arom}$), 1560 (C=N), 1180, 1120 (C–O–C). ^{1}H NMR spectrum, δ, ppm: 0.99–1.25 m [6H, $(\underline{CH_3})_2CH$], 2.00–2.31 m (4H, $CH\underline{CH_2}CH\underline{CH_2}$), 3.37–3.72 m (3H, $CHOCH_2$), 3.99–5.15 m (2H, CH in furanone), 6.57 t.t (1H^n, *J* 7.2, *J* 1.1 Hz), 6.66 m (2H^o), 7.09 m (2H^m), 6.94 d (1H, CH in thiazolidone, *J* 7.1 Hz), 10.80 d, 11.56 br.s (1H, NH, *J* 4.8 Hz). Found, %: C 59.25; H 6.25; N 7.80; S 8.50. $C_{18}H_{22}N_2O_4S$. Calculated, %: C 59.67; H 6.08; N 7.73; S 8.84.

5-{5-[(Pentoxymethyl)-2-oxotetrahydrofuran-3-yl] methyl}-2-*p*-tolylaminothiazol-4(5*H*)-one (VIf).. Yield 70%, mp 112–113°C (water–ethanol, 1 : 2), R_f 0.65 (B). IR spectrum, ν, cm^{-1}: 3250, 3190 (NH), 3080 (=CH), 1755 (C=O$_{lactone}$), 1675 (C=O$_{cyclic\ amide}$), 1610 (C=C$_{arom}$), 1560 (C=N), 1180, 1120 (C–O–C). ^{1}H NMR spectrum, δ, ppm: 1.01–1.09 m (3H, CH_3), 1.20–1.53 m (6H, CH_2), 1.61–2.38 m (4H, CH$\underline{CH_2}$CH$\underline{CH_2}$), 2.34 s (3H, CH_3-Ar), 3.42–3.68 m (4H, CH_2OCH_2), 4.05–4.16 m, 4.22 t.t, 4.45–4.56 m (1H, CH in furanone, *J* 10.3, *J* 4.8 Hz), 4.34–4.44 m, 4.55–4.68 m (1H, CHO in furanone), 6.89 d.d (1H, CH in thiazolidone, *J* 8.3, *J* 3.6 Hz), 7.10, 7.27, 7.61 d (1H$_{arom}$, *J* 7.9, *J* 8.7, *J* 7.9 Hz), 10.89 s and 11.53 br.s (1H, NH). Found, %: C 62.25; H 7.00; N 7.10; S 8.10. $C_{21}H_{28}N_2O_4S$. Calculated, %: C 62.35; H 6.98; N 6.93; S 7.93.

5-{5-[(Pentoxymethyl)-2-oxotetrahydrofuran-3-yl] methyl}-2-*p*-ethoxyphenylaminothiazol-4(5*H*)-one (VIg). Yield 70%, mp 173–174°C (water–ethanol, 1 : 4), R_f 0.54 (B). IR spectrum, ν, cm^{-1}: 3250, 3190 (NH), 3080 (=CH), 1755 (C=O$_{lactone}$), 1675 (C=O$_{cyclic\ amide}$), 1610 (C=C$_{arom}$), 1560 (C= N), 1180, 1120 (C–O–C). ^{1}H NMR spectrum, δ, ppm: 1.01–1.09 m (3H, CH_3), 1.20–1.53 m (6H, CH_2), 1.42 t (3H, $\underline{CH_3}CH_2O$, *J* 6.07 Hz), 1.60–2.47 m (4H, CH$\underline{CH_2}$CH$\underline{CH_2}$), 3.44–3.63 m (4H, CH_2OCH_2), 4.02 q (2H, $H_3C\underline{H_2}O$, *J* 7.1 Hz), 4.13–4.42 m (1H, CH in furanone), 4.46–4.71 m (1H, CHO in furanone), 6.89 d.d (1H, CH in thiazolidone, *J* 8.3, *J* 3.6 Hz), 6.81 d (2H$_{arom}$, *J* 8.7 Hz), 6.92–7.05 m (1H$_{arom}$), 7.63 d (1H$_{arom}$, *J* 8.7 Hz), 10.78 d (1H, NH, *J* 6.3 Hz). Found, %: C 59.60; H 6.80; N 6.75; S 7.70. $C_{22}H_{30}N_2O_5S$. Calculated, %: C 60.00; H 6.91; N 6.36; S 7.27.

5-{5-[(Pentoxymethyl)-2-oxotetrahydrofuran-3-yl] methyl}-2-phenylaminothiazol-4(5*H*)-one (VIh). Yield 75%, mp 129–130°C (water–ethanol, 1:2), R_f 0.48 (B). IR spectrum, ν, cm^{-1}: 3250, 3190 (NH), 3080 (=CH), 1755 (C=O$_{lactone}$), 1675 (C=O$_{cyclic\ amide}$), 1610 (C=C$_{arom}$), 1560 (C=N), 1180, 1120 (C–O–C). ^{1}H NMR spectrum, δ, ppm: 0.98–1.02 m (3H, CH_3), 1.18–1.49 m (6H, CH_2), 2.01–2.33 m (4H, CH$\underline{CH_2}$CH$\underline{CH_2}$), 3.38–3.77 m (4H, CH_2OCH_2), 3.95–5.16 m (2H, CH in furanone), 6.58 t.t (1H^p, *J* 7.2, *J* 1.1 Hz), 6.68 m (2H^o), 7.10 m (2H^m), 6.91 d (1H, CH in thiazolidone, *J* 7.1 Hz), 10.76 d, 11.52 br.s (1H, NH, *J* 4.8 Hz). Found, %: C 60.90; H 6.80; N 7.68; S 8.90. $C_{20}H_{26}N_2O_5S$. Calculated, %: C 61.54; H 6.71; N 7.18; S 8.20.

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