

## Vanillal Esters in Reaction with 2-Naphthylamine and 1,3-Diketones

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**Abstract**—Analogues of natural alkaloids of acridone series, derivatives of 4-(9-alkyl-11-oxo-7,8,9,10,11,12-hexahydrobenzo[*a*]acridin-12-yl) and 4-(12-oxo-12*H*-benzo[*f*]indeno[1,2-*b*]quinolin-13-yl)-2-ethoxyphenyl carboxylates were synthesized by a three-component condensation of vanillal with 2-naphthylamine and 1,3-cyclohexanedione, dimedone, phendione, or 1,3-indanedione.

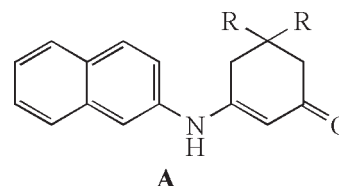
Fragment of vegetable phenols is a principal pharmacophore group of the naturally-occurring alkaloids of acridone series. We formerly established [1] that an introduction into the acridone molecule of a vanillin fragment containing both ether and ester moieties with an alkyl substituent C<sub>1</sub>–C<sub>7</sub> resulted in increased solubility of the product in the main organic solvents and fats facilitating preparation of preforms of drugs.

In this study we selected as an aldehyde part for a three-component heterocyclization vanillal (4-hydroxy-3-ethoxybenzaldehyde), the closest structural analog of vanillin, available natural phenol extensively used in the preparation of fragrant substances and drugs [2–4]. The vanillal was preliminary esterified with chlorides of alkylcarboxylic acids C<sub>1</sub>–C<sub>4</sub> into esters **IIa–IIg**. The condensation was carried out by boiling compounds **IIa–IIg** with 2-naphthylamine (**I**) and 1,3-cyclohexanedione (**IIIa**), 5,5-dimethyl-1,3-cyclohexanedione (dimedone) (**IIIb**), 5-phenyl-1,3-cyclohexanedione (phendione) (**IIIc**), or 1,3-indanedione (**IV**) in ethanol or butanol for 0.5–4 h.

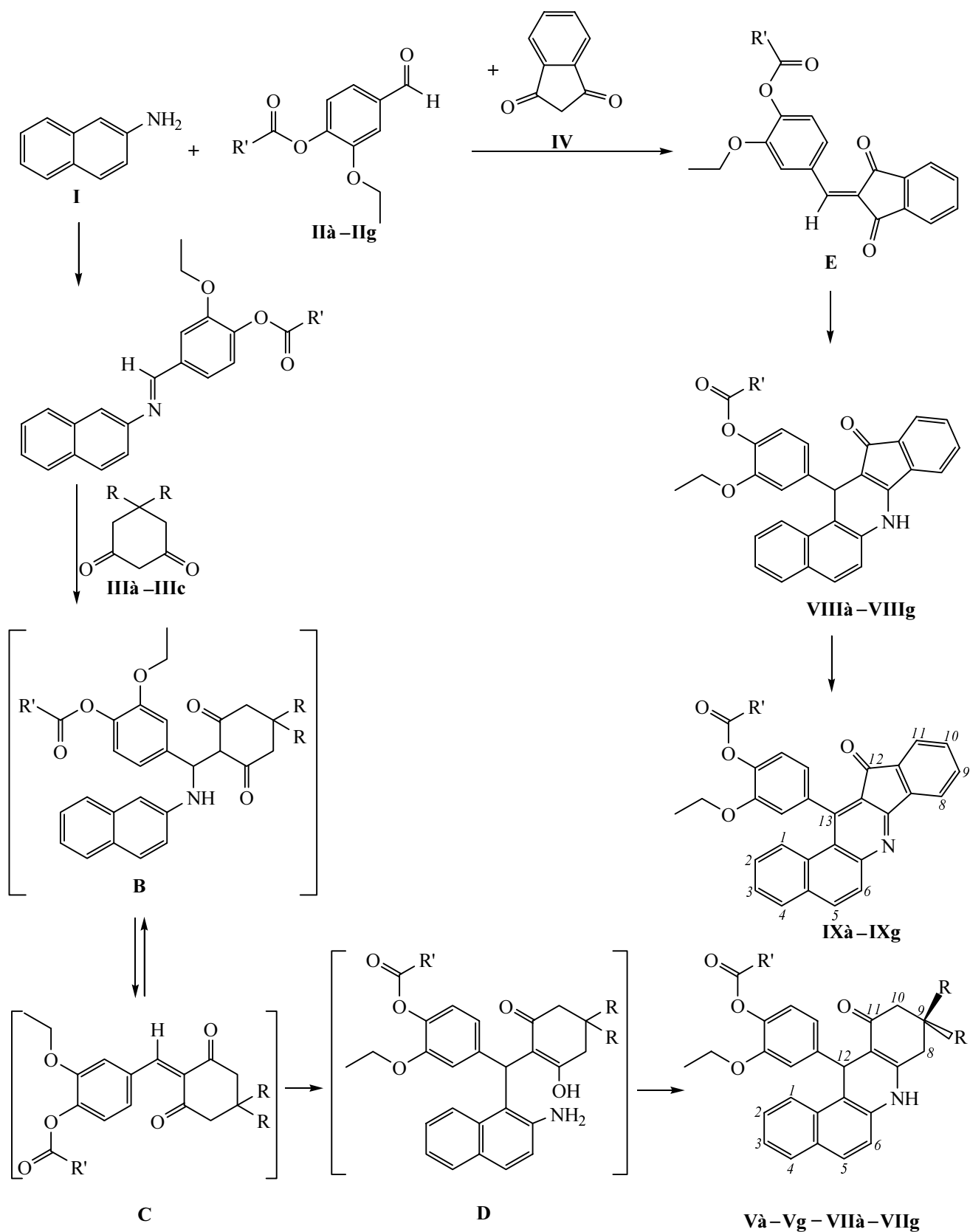
The reaction time and the yield of the ester is affected by the sterical effect of the acyl component. The yield of 4-(11-oxo-7,8,9,10,11,12-hexahydrobenzo[*a*]acridin-12-yl)-2-ethoxyphenyl isocaproate (**Ve**) was 52% and the reaction time 4 h, whereas 4-(11-oxo-7,8,9,10,11,12-hexahydrobenzo[*a*]acridin-12-yl)-2-ethoxyphenyl acetate (**Vb**) was obtained in a 97% yield in 30 min.

Considering the mechanism of the three-component condensation of esters **II** with 1,3-cyclohexanedione [1] we assumed that from 2-naphthylamine and 1,3-diketones formed intermediately ketone imines which further reacted

with vanillal esters **II**. In this study we synthesized the presumed ketone imines **A** and brought into the reaction with esters **IIa–IIg**. Only the initial ketone imine was isolated from the reaction mixture. Probably the ketone imine reacts with ester **II** only *in statu nascendi* in the three-component reaction mixture, and formation of 4-(11-oxo-7,8,9,10,11,12-hexahydrobenzo[*a*]acridin-12-yl)-2-ethoxyphenyl carboxylates takes another route.



We failed to isolate in a pure state arylidene-1,3-diketone **C** in reaction of 1,3-diketone with ester **II**, therefore in the scheme of the three-component condensation of 2-naphthylamine, 1,3-diketone, and vanillal esters a formation of an unstable iminium intermediate **B** was assumed that decomposed into arylidene-1,3-diketone **C** and 2-naphthylamine (**I**). The latter possessing the highest electron density on the carbon in the  $\alpha$ -position with respect to amino group undergoes addition to the double bond of arylidene-1,3-diketone **C** furnishing arylaminoketoenol **D** which via heterocyclization with elimination of water molecule affords the final reaction product, 4-(11-oxo-7,8,9,10,11,12-hexahydrobenzo[*a*]acridin-12-yl)- (Va–Vg), 4-(9,9-dimethyl-11-oxo-7,8,9,10,11,12-hexahydrobenzo[*a*]acridin-12-yl)- (VIa–VIg), or 4-(11-oxo-9-phenyl)-7,8,9,10,11,12-hexahydrobenzo[*a*]acridin-12-yl)- (VIIa–VIIg) -2-ethoxyphenyl carboxylates.



R = H (**IIIa**, **V**), Me (**IIIb**, **VI**), H, C<sub>6</sub>H<sub>5</sub> (**IIIc**, **VII**); R' = H (**a**), Me (**b**), C<sub>2</sub>H<sub>5</sub> (**c**), C<sub>3</sub>H<sub>7</sub> (**d**), *iso*-C<sub>3</sub>H<sub>7</sub> (**e**), CH<sub>2</sub>CH(CH<sub>3</sub>)<sub>2</sub> (**f**), C<sub>6</sub>H<sub>5</sub> (**g**).

It should be noted that synthesized 4-(11-oxo-9-phenyl)-7,8,9,10,11,12-hexahydrobenzo[*a*]acridin-12-yl)-2-ethoxyphenyl carboxylates **VIIa–VIIg** contained two asymmetric atoms  $C^9$  and  $C^{12}$  and formed as a mixture of diastereomers with a pseudoaxial and pseudoequatorial position of the phenyl group at the atom  $C^9$  in approximately equal amounts as revealed by  $^1\text{H}$  NMR spectroscopy.

We found that phendione (**IIIc**) required higher temperature for entering into the three-component condensation than cyclohexanedione (**IIIa**) and dimedone (**IIIb**) since 4-(11-oxo-9-phenyl)-7,8,9,10,11,12-hexahydrobenzo[*a*]acridin-12-yl)-2-ethoxyphenyl carboxylates **VIIa–VIIg** formed from the phendione in better yield when reaction was performed in butanol. In ethanol the yield of the final products did not exceed 10%, and 4-(11-oxo-7,8,9,10,11,12-hexahydrobenzo[*a*]acridin-12-yl)-2-ethoxyphenyl carboxylates **Va–Vg** and **VIa–VIg** formed in butanol in a yield no more than 15%.

The formation of arylidene-1,3-indanediones **E** in the reaction with 1,3-indanedione (**IV**) was proved in [5]. 4-(12,13-Dihydro-12-7*H*-benzo[*f*]indeno[1,2-*b*]quinolin-13-yl)-2-ethoxyphenyl carboxylates **VIIIa–VIIIg** in all experiments were obtained in a mixture with 4-(12-oxo-12*H*-benzo[*f*]indeno[1,2-*b*]quinolin-13-yl)-2-ethoxyphenyl carboxylates **IXa–IXg** in a ratio 1:9 according to  $^1\text{H}$  NMR spectra. The attempt to isolate compounds **VIIIa–VIIIg** from the reaction mixture in an individual state failed for the substances suffered further oxidation. Inasmuch as the compounds **VIIIa–VIIIg** and **IXa–IXg** defied the attempts at separation we subjected at once the mixture to dehydration by boiling it in the nitrobenzene for 3–4 h till formation of 4-(12-oxo-12*H*-benzo[*f*]indeno[1,2-*b*]quinolin-13-yl)-2-ethoxyphenyl carboxylates **IXa–IXg**.

The structure of compounds **Va–Vg–VIIa–VIIg**, and **IXa–IXg** was confirmed by  $^1\text{H}$  NMR, IR, and mass spectra. In the  $^1\text{H}$  NMR spectra of benzo[*a*]acridines **Va–Vg–VIIa–VIIg** the position and multiplicity of aromatic proton signals correspond to the benzo[*a*]acridine structure [6]. The methine proton ( $H^{12}$ ) of the dihydropyridine ring gave rise to a singlet at 5.70–5.95 ppm. The downfield shift of this signal as compared to the usual position of the methine protons signals in the spectra of cyclic compounds [7] is due to the anisotropic effect of the adjacent aromatic ring.

In the  $^1\text{H}$  NMR spectra of compounds **VIIa–VIIg** the signals of protons attached to  $C^9$  were identified as two multiplets in the region 3.21–3.41 ppm. According to the chemical shift value and the half-width the more

upfield signal was assigned to the axial proton  $H^9$ , and the more downfield signal was identified with the equatorial proton  $H^9$ .

In the spectra of isomer mixtures of 4-(11-oxo-9-phenyl)-7,8,9,10,11,12-hexahydrobenzo[*a*]acridin-12-yl)-2-ethoxyphenyl carboxylates **VIIa–VIIg** were detected the singlet signals of protons at the nitrogen and  $C^{12}$  whose integral intensities corresponded to those of the protons at the  $C^9$  atom. In the isomer with the axial phenyl group linked to  $C^9$  the proton of the NH group and  $H^{12}$  occur in the shielding region of the benzene ring, and the corresponding signals appear upfield with respect to those from the isomer with the equatorial phenyl group.

The NMR spectra of compounds **IXa–IXg** possess signals of aromatic protons whose position and multiplicity correspond to benzoindenoquinoline structure.

The IR spectra of benzo[*a*]acridines **Va–Vg–VIIa–VIIg** indicate the presence of a secondary amino group (an absorption band in the region 3276–3260  $\text{cm}^{-1}$ ) and of a carbonyl group (an absorption band in the region 1768–1753  $\text{cm}^{-1}$ ). The carbonyl of the ester group appears as a strong band in the region 1608–1594  $\text{cm}^{-1}$ . The fragments C–O–C present in the molecules give rise to the bands in the region 1276–1242  $\text{cm}^{-1}$ . The absorption bands of the stretching vibrations of alkyl groups and cycloaliphatic CH bonds appear at 2980–2952  $\text{cm}^{-1}$ . In the IR spectra of compounds **IXa–IXg** medium bands observed at 1566–1562  $\text{cm}^{-1}$  belong to the stretching vibrations of the carbonyl group in conjugation with the benzene and naphthalene rings. The carbonyl of the ester group appears as a strong band in the region 1768–1763  $\text{cm}^{-1}$ . The lack in the spectra of compounds **IXa–IXg** absorption bands in the region 3276–3260  $\text{cm}^{-1}$  characteristic of amino group evidences the cyclic structure of the tertiary amine.

In the mass spectra of benzo[*a*]acridines **Va–Vg–VIIa–VIIg** the peaks of molecular ions  $M^+$  ( $I_{\text{rel}}$  10–84%) are present. The most abundant peak (100%) in the spectra of compounds **Va–Vg–VIIa–VIIg** was that of the ion  $[M-C_2H_5OR'COOC_6H_3]^+$  which proved to be stable and hardly suffered fragmentation. Besides in the mass spectra of all compounds **Va–Vg–VIIa–VIIg** a peak is present with  $m/z$  192 (16–30%) generated by elimination from the ion  $[M-C_2H_5OR'COOC_6H_3]^+$  of fragment  $\text{CH}_2\text{CH}_2\text{CO}$  for compounds **Va–Vg**,  $(\text{CH}_3)_2\text{CCH}_2\text{CO}$  for dimethyl derivatives **VIa–VIg**, and  $\text{C}_6\text{H}_5\text{CHCH}_2\text{CO}$  for compounds **VIIa–VIIg**. The analysis of mass spectra of compounds **IXa–IXg** revealed their stability against the electron impact.

The spectra contain very strong (100%) peaks of molecular ions  $M^+$  and relatively strong peaks of ions with  $m/z$  280 (39–50%) corresponding to the ions  $[M-OC_2H_5 RCOOC_6H_3]^+$ .

### EXPERIMENTAL

IR spectra of compounds were recorded on a Fourier-spectrophotometer Protege-460 (Nicolet) from thin films or pellets with KBr.  $^1H$  NMR spectra were registered on spectrometers AC-500 (500 MHz, Bruker) or BS-587A (100 MHz, Tesla) from 5% solutions in DMSO- $d_6$ , chemical shifts were measured from internal reference TMS. Mass spectra were taken on a GS-MS instrument Chrommas GC/MS Hewlett Packard 5890/5972, column HP-5MS (70 eV).

**4-Formyl-2-ethoxyphenyl methanoate (IIa).** To a solution of 1.66 g (0.01 mol) of vanillal and 2.06 g (0.01 mol) of dicyclohexylcarbodiimide in 500 ml of anhydrous benzene was added 0.12 mol of 99% formic acid. The reaction mixture was maintained with intermittent shaking for 24–36 h at 20–23°C. After neutralization with  $NaHCO_3$  the benzene solution was dried on  $CaCl_2$ , the solvent was distilled off, and the residue was recrystallized from methanol. Yield 73%, colorless crystalline substance, mp 47–48°C. IR spectrum,  $cm^{-1}$ : 3110, 3081, 3015, 2988, 2940, 2840, 2813, 2744, 1733, 1698, 1599, 1505, 1439, 1391, 1276, 1267, 1197, 1160, 1138, 1098, 1040, 895, 868, 851, 824, 800, 745, 618, 590.  $^1H$  NMR spectrum,  $\delta$ , ppm: 1.46 t (3H, Me), 4.18 q (2H,  $CH_2$ ), 7.22 d, 7.51 m (3H,  $C_6H_3$ ), 8.32 s [1H, OC(O)H], 9.97 s (1H, CHO). Mass spectrum,  $m/z$  ( $I_{rel}$ , %):  $[M]^+$  194 (10),  $[M-OCH]^+$  166 (100). Found, %: C 62.03; H 5.28.  $C_{10}H_{10}O_4$ . Calculated, %: C 61.85; H 5.19.

**Vanillal esters IIb–IIg.** To a solution of 3.32 g (0.02 mol) of vanillal in 500 ml of anhydrous  $CH_2Cl_2$  was added 1.97 g (0.025 mol) of anhydrous pyridine and by small portions was added while stirring by shaking the reaction flask 0.2 mol of an appropriate alkylcarboxylic acid chloride. The reaction mixture was heated at reflux for 1 h,  $CH_2Cl_2$  was distilled off while heating on a water bath, the residue was dissolved in 500 ml of benzene, the solution was thrice washed with water, thrice with 5% water solution of  $NaHCO_3$ , and dried on  $CaCl_2$ . The solvent was distilled off, the residue was either distilled in a vacuum (**II d** and **II f**) or recrystallized from a mixture benzene–hexane (**II b**, **II c**, **II e**, and **II g**).

The distilled off  $CH_2Cl_2$  and benzene may be used repeatedly after appropriate treatment (distillation from  $P_2O_5$  with Vigreux column).

**4-Formyl-2-ethoxyphenyl ethanoate (IIb).** Yield 87%, colorless crystalline substance, mp 33–34°C. IR spectrum,  $cm^{-1}$ : 3080, 2982, 2934, 2907, 2880, 2850, 2830, 2736, 1768, 1694, 1600, 1592, 1509, 1479, 1441, 1392, 1370, 1320, 1288, 1273, 1210, 1197, 1156, 1040, 1011, 973, 900, 870, 832, 800, 786, 745, 726, 667, 632, 586, 528.  $^1H$  NMR spectrum,  $\delta$ , ppm: 1.41 t (3H,  $MeCH_2$ ), 2.32 s [3H, MeC(O)], 4.11 q (2H,  $CH_2$ ), 7.20 d, 7.45 m (3H,  $C_6H_3$ ), 9.92 s (1H, CHO). Mass spectrum,  $m/z$  ( $I_{rel}$ , %):  $[M]^+$  208 (13),  $[M-OCMe]^+$  166 (100),  $[M-EtOC_6H_3(O)CHO]^+$  43 (75). Found, %: C 63.72; H 5.84.  $C_{11}H_{12}O_4$ . Calculated, %: C 63.46; H 5.77.

**4-Formyl-2-ethoxyphenyl propanoate (IIc).** Yield 84%, colorless crystalline substance, mp 45–47°C. IR spectrum,  $cm^{-1}$ : 3115, 3080, 3055, 2985, 2942, 2890, 2875, 2840, 2795, 2740, 1760, 1697, 1601, 1589, 1508, 1480, 1465, 1435, 1401, 1380, 1353, 1324, 1288, 1264, 1206, 1161, 1140, 1115, 1075, 1040, 1007, 973, 890, 872, 826, 800, 784, 585.  $^1H$  NMR spectrum,  $\delta$ , ppm: 1.35 m (6H,  $2MeCH_2$ ), 2.65 q (2H,  $CH_2C=O$ ), 4.13 q (2H,  $CH_2O$ ), 7.16 q, 7.45 m (3H,  $C_6H_3$ ), 9.91 s (1H, CHO). Mass spectrum,  $m/z$  ( $I_{rel}$ , %):  $[M]^+$  222 (12),  $[M-OCCH_2Me]^+$  166 (100),  $[M-EtOC_6H_3(O)CHO]^+$  57 (78). Found, %: C 65.07; H 6.44.  $C_{12}H_{14}O_4$ . Calculated, %: C 64.86; H 6.31.

**4-Formyl-2-ethoxyphenyl butanoate (II d).** Yield 92%, colorless liquid, bp 145–146°C (0.5 mm Hg),  $d_{20}^{20}$  1.2009,  $n_D^{20}$  1.5272. IR spectrum,  $cm^{-1}$ : 3114, 3077, 3055, 2983, 2941, 2890, 2875, 2843, 2795, 2740, 1761, 1698, 1600, 1589, 1506, 1480, 1465, 1440, 1400, 1381, 1353, 1325, 1288, 1264, 1206, 1160, 1140, 1113, 1075, 1040, 1006, 973, 890, 872, 826, 800, 784, 585.  $^1H$  NMR spectrum,  $\delta$ , ppm: 1.03 t (3H, Me), 1.42 t (3H,  $MeCH_2O$ ), 1.64 m (2H,  $CH_2$ ), 2.52 t (2H,  $CH_2$ ), 4.12 q (2H,  $MeCH_2O$ ), 7.17 d, 7.44 m (3H,  $C_6H_3$ ), 9.92 s (1H, CHO). Mass spectrum,  $m/z$  ( $I_{rel}$ , %):  $[M]^+$  236 (9),  $[M-OC(CH_2)_2Me]^+$  166 (100),  $[M-EtOC_6H_3(O)CHO]^+$  71 (58). Found, %: C 66.34; H 7.07.  $C_{13}H_{16}O_4$ . Calculated, %: C 66.09; H 6.83.  $M$  236.3.

**4-Formyl-2-ethoxyphenyl isobutyrate (II e).** Yield 93%, colorless crystalline substance, mp 45–46°C. IR spectrum,  $cm^{-1}$ : 3120, 3080, 3055, 2990, 2975, 2939, 2895, 2880, 2842, 2790, 2740, 1752, 1697, 1600, 1586, 1508, 1420, 1435, 1400, 1385, 1320, 1288, 1262, 1160, 1117, 1099, 1033, 974, 916, 870, 821, 800, 785, 751, 655, 580.  $^1H$  NMR spectrum,  $\delta$ , ppm: 1.27 d (6H,  $Me_2C$ ), 1.38 t (3H, Me), 2.78 m (1H, CH), 4.08 q (2H,  $CH_2$ ), 7.10 d, 7.40 m (3H,  $C_6H_3$ ), 9.91 s (1H, CHO). Mass spectrum,  $m/z$  ( $I_{rel}$ , %):  $[M]^+$  236 (16),  $[M-OCCHMe_2]^+$  166 (100),  $[M-$



$\text{EtOC}_6\text{H}_3(\text{O})\text{CHO}]^+$  71 (77). Found, %: C 66.29; H 7.01.  $\text{C}_{13}\text{H}_{16}\text{O}_4$ . Calculated, %: C 66.09; H 6.83.

**4-Formyl-2-ethoxyphenyl isovalerate (III<sub>f</sub>).** Yield 82%, colorless liquid, bp 132–33°C (0.5 mm Hg),  $d_{20}^{20}$  1.0954,  $n_D^{20}$  1.5180. IR spectrum,  $\text{cm}^{-1}$ : 3118, 3070, 3050, 3020, 2963, 2936, 2874, 2834, 2785, 2737, 1764, 1699, 1600, 1503, 1467, 1434, 1391, 1370, 1321, 1280, 1272, 1180, 1150, 1119, 1092, 1041, 973, 915, 897, 869, 830, 786, 744, 730, 650, 580.  $^1\text{H}$  NMR spectrum,  $\delta$ , ppm: 1.08 d (6H,  $\text{Me}_2\text{C}$ ), 1.40 t (3H,  $\text{MeCH}_2\text{O}$ ), 1.40–2.85 m (3H,  $\text{CH}$   $\theta$   $\text{CH}_2$ ), 4.11 q (2H,  $\text{MeCH}_2\text{O}$ ), 7.12 d, 7.42 m (3H,  $\text{C}_6\text{H}_3$ ), 9.91 s (1H, CHO). Mass spectrum,  $m/z$  ( $I_{\text{rel}}$ , %):  $[M]^+$  250 (11),  $[M - \text{OCCH}_2\text{CHMe}_2]^+$  166 (100),  $[M - \text{EtOC}_6\text{H}_3(\text{O})\text{CHO}]^+$  85 (44). Found, %: C 67.49; H 7.41.  $\text{C}_{14}\text{H}_{18}\text{O}_4$ . Calculated, %: C 67.18; H 7.25.

**4-Formyl-2-ethoxyphenyl benzoate (III<sub>g</sub>).** Yield 75%, colorless crystals, mp 79–80°C. IR spectrum,  $\text{cm}^{-1}$ : 3110, 3075, 2970, 2940, 2875, 2846, 2793, 1750, 1698, 1600, 1592, 1410, 1400, 1382, 1320, 1284, 1157, 1110, 1030, 972, 821, 800, 783, 751, 652, 580.  $^1\text{H}$  NMR spectrum,  $\delta$ , ppm: 1.30 t (3H,  $\text{MeCH}_2\text{O}$ ), 4.10 q (2H,  $\text{MeCH}_2\text{O}$ ), 7.307.60 m (6H,  $\text{H}_{\text{arom}}$ ), 8.10–8.30 m (2H,  $\text{H}_{\text{arom}}$ ), 9.94 s (1H, CHO). Mass spectrum,  $m/z$  ( $I_{\text{rel}}$ , %):  $[M]^+$  258 (16),  $[M - \text{OCC}_6\text{H}_5]^+$  153 (100),  $[M - \text{EtOC}_6\text{H}_3(\text{O})\text{CHO}]^+$  105 (50). Found, %: C 71.15; H 5.20.  $\text{C}_{16}\text{H}_{14}\text{O}_4$ . Calculated, %: C 71.11; H 5.18.

**4-(11-Oxo-7,8,9,10,11,12-hexahydrobenzo[*a*]-acridin-12-yl)-2-ethoxyphenyl carboxylates Va–Vg.** To a solution of 1.43 g (0.01 mol) of 2-naphthylamine (I) in 50 ml of ethanol was added 1.12 g (0.01 mol) of 1,3-cyclohexanedione (III<sub>a</sub>), and 0.01 mol of ester II<sub>a</sub>–II<sub>g</sub>. The mixture was heated at reflux for 0.5–4 h depending on the length of the acid rest in the vanillal ester. On cooling the reaction mixture the crystalline precipitate was separated, washed with hot methanol, and recrystallized from benzene.

**4-(11-Oxo-7,8,9,10,11,12-hexahydrobenzo[*a*]-acridin-12-yl)-2-ethoxyphenyl formate (Va).** Yield 70%, colorless crystals, mp 287°C. IR spectrum,  $\text{cm}^{-1}$ : 3260, 3190, 3080, 2980, 1754, 1600, 1523, 1490, 1467, 1383, 1262, 1194, 1186, 1134, 1120, 1091, 979, 823.  $^1\text{H}$  NMR spectrum,  $\delta$ , ppm: 1.37 t (3H,  $\text{MeCH}_2\text{O}$ ), 3.98 q (2H,  $\text{MeCH}_2\text{O}$ ), 8.20 s (1H, OCOH), 1.98 m (2H,  $\text{CH}_2$ ), 2.30 m (2H,  $\text{CH}_2$ ), 2.59 m (2H,  $\text{CH}_2$ ), 5.70 s (1H, CH), 6.40 m (2H,  $\text{H}_{\text{arom}}$ ), 6.90 s (1H,  $\text{H}_{\text{arom}}$ ), 7.30 m (3H,  $\text{H}_{\text{arom}}$ ), 7.60–7.90 m (3H,  $\text{H}_{\text{arom}}$ ), 9.50 s (1H, NH). Mass spectrum,  $m/z$  ( $I_{\text{rel}}$ , %):  $[M]^+$  413 (15), 248 (100), 192 (23), 165 (10). Found, %: C 75.50; H 5.54; N 3.41.  $\text{C}_{26}\text{H}_{23}\text{NO}_4$ . Calculated, %: C 75.54; H 5.56; N 3.39.

**4-(11-Oxo-7,8,9,10,11,12-hexahydrobenzo[*a*]-acridin-12-yl)-2-ethoxyphenyl acetate (Vb).** Yield 97%, colorless crystals, mp 292°C. IR spectrum,  $\text{cm}^{-1}$ : 3264, 3189, 3080, 2973, 1756, 1600, 1522, 1494, 1461, 1388, 1269, 1190, 1191, 1133, 1125, 1094, 979, 832.  $^1\text{H}$  NMR spectrum,  $\delta$ , ppm: 1.30 t (3H,  $\text{MeCH}_2\text{O}$ ), 3.95 q (2H,  $\text{MeCH}_2\text{O}$ ), 2.15 s (3H, OCOMe), 1.95 m (2H,  $\text{CH}_2$ ), 2.30 m (2H,  $\text{CH}_2$ ), 2.60 m (2H,  $\text{CH}_2$ ), 5.90 s (1H, CH), 6.50 d (1H,  $\text{H}_{\text{arom}}$ ,  $J$  6.8 Hz), 6.65 d (1H,  $\text{H}_{\text{arom}}$ ,  $J$  6.7 Hz), 7.10 s (1H,  $\text{H}_{\text{arom}}$ ), 7.25 m (2H,  $\text{H}_{\text{arom}}$ ), 7.40 t (1H,  $\text{H}_{\text{arom}}$ ), 7.68 d (1H,  $\text{H}_{\text{arom}}$ ,  $J$  6.7 Hz), 7.74 d (1H,  $\text{H}_{\text{arom}}$ ,  $J$  6.3 Hz), 7.90 d (1H,  $\text{H}_{\text{arom}}$ ,  $J$  6.8 Hz), 9.45 s (1H, NH). Mass spectrum,  $m/z$  ( $I_{\text{rel}}$ , %):  $[M]^+$  427 (13), 248 (100), 192 (23), 179 (20). Found, %: C 75.86; H 5.87; N 3.25.  $\text{C}_{27}\text{H}_{25}\text{NO}_4$ . Calculated, %: C 75.88; H 5.85; N 3.28.

**4-(11-Oxo-7,8,9,10,11,12-hexahydrobenzo[*a*]-acridin-12-yl)-2-ethoxyphenyl propionate (Vc).** Yield 90%, colorless crystals, mp 256°C. IR spectrum,  $\text{cm}^{-1}$ : 3269, 3189, 3075, 2972, 1755, 1590, 1502, 1465, 1388, 1269, 1189, 1194, 1132, 1125, 1090, 983, 832.  $^1\text{H}$  NMR spectrum,  $\delta$ , ppm: 1.30 t (3H,  $\text{MeCH}_2\text{O}$ ), 3.93 q (2H,  $\text{MeCH}_2\text{O}$ ), 1.19 t (3H,  $\text{OCOCH}_2\text{Me}$ ), 1.26 q (2H,  $\text{OCOCH}_2\text{Me}$ ), 1.95 m (2H,  $\text{CH}_2$ ), 2.27 m (2H,  $\text{CH}_2$ ), 2.64 m (2H,  $\text{CH}_2$ ), 5.90 s (1H, CH), 6.49 d (1H,  $\text{H}_{\text{arom}}$ ,  $J$  6.9 Hz), 6.62 d (1H,  $\text{H}_{\text{arom}}$ ,  $J$  7.0 Hz), 7.08 s (1H,  $\text{H}_{\text{arom}}$ ), 7.27 m (2H,  $\text{H}_{\text{arom}}$ ), 7.38 t (1H,  $\text{H}_{\text{arom}}$ ), 7.68 d (1H,  $\text{H}_{\text{arom}}$ ,  $J$  7.0 Hz), 7.71 d (1H,  $\text{H}_{\text{arom}}$ ,  $J$  6.8 Hz), 7.90 d (1H,  $\text{H}_{\text{arom}}$ ,  $J$  7.2 Hz), 9.50 s (1H, NH). Mass spectrum,  $m/z$  ( $I_{\text{rel}}$ , %):  $[M]^+$  441 (12), 248 (100), 193 (16), 192 (16). Found, %: C 76.22; H 6.12; N 3.15.  $\text{C}_{28}\text{H}_{27}\text{NO}_4$ . Calculated, %: C 76.19; H 6.12; N 3.17.

**4-(11-Oxo-7,8,9,10,11,12-hexahydrobenzo[*a*]-acridin-12-yl)-2-ethoxyphenyl butyrate (Vd).** Yield 67%, colorless crystals, mp 262°C. IR spectrum,  $\text{cm}^{-1}$ : 3263, 3187, 3070, 2976, 1753, 1598, 1502, 1465, 1388, 1264, 1196, 1192, 1144, 1129, 1096, 983, 832.  $^1\text{H}$  NMR spectrum,  $\delta$ , ppm: 1.28 t (3H,  $\text{MeCH}_2\text{O}$ ), 3.95 q (2H,  $\text{MeCH}_2\text{O}$ ), 1.00 t [3H,  $\text{OCO}(\text{CH}_2)_2\text{Me}$ ], 1.70 m (2H,  $\text{OCOCH}_2-\text{CH}_2\text{Me}$ ), 2.65 m (2H,  $\text{OCOCH}_2\text{CH}_2\text{Me}$ ), 1.90 m (2H,  $\text{CH}_2$ ), 2.20 m (2H,  $\text{CH}_2$ ), 2.58 m (2H,  $\text{CH}_2$ ), 5.88 C (1H, CH), 6.48 d (1H,  $\text{H}_{\text{arom}}$ ,  $J$  7.2 Hz), 6.65 d (1H,  $\text{H}_{\text{arom}}$ ,  $J$  7.0 Hz), 7.14 s (1H,  $\text{H}_{\text{arom}}$ ), 7.22 m (2H,  $\text{H}_{\text{arom}}$ ), 7.40 t (1H,  $\text{H}_{\text{arom}}$ ), 7.68 d (1H,  $\text{H}_{\text{arom}}$ ,  $J$  6.9 Hz), 7.73 d (1H,  $\text{H}_{\text{arom}}$ ,  $J$  7.2 Hz), 7.95 d (1H,  $\text{H}_{\text{arom}}$ ,  $J$  7.6 Hz), 9.48 s (1H, NH). Mass spectrum,  $m/z$  ( $I_{\text{rel}}$ , %):  $[M]^+$  455 (18), 248 (100), 207 (15), 192 (20). Found, %: C 76.72; H 6.60; N 2.96;  $\text{C}_{29}\text{H}_{29}\text{NO}_4$ . Calculated, %: C 76.75; H 6.61; N 2.98.

**4-(11-Oxo-7,8,9,10,11,12-hexahydrobenzo[*a*]-acridin-12-yl)-2-ethoxyphenyl isobutyrate (Ve).** Yield

63%, colorless crystals, mp 292°C. IR spectrum,  $\text{cm}^{-1}$ : 3260, 3192, 3087, 2974, 1758, 1583, 1519, 1495, 1469, 1385, 1264, 1192, 1180, 1137, 1096, 975, 821.  $^1\text{H}$ NMR spectrum,  $\delta$ , ppm: 1.28 t (3H,  $\text{MeCH}_2\text{O}$ ), 3.95 q (2H,  $\text{MeCH}_2\text{O}$ ), 1.20 d [6H,  $\text{OCOCHMe}_2$ ,  $J$  7.0 Hz], 2.70 m [1H,  $\text{OCOCHMe}_2$ ], 1.97 m (2H,  $\text{CH}_2$ ), 2.30 m (2H,  $\text{CH}_2$ ), 2.63 m (2H,  $\text{CH}_2$ ), 5.89 s (1H, CH), 6.50 d (1H,  $\text{H}_{\text{arom}}$ ,  $J$  7.8 Hz), 6.62 d (1H,  $\text{H}_{\text{arom}}$ ,  $J$  7.0 Hz), 7.10 s (1H,  $\text{H}_{\text{arom}}$ ), 7.27 m (1H,  $\text{H}_{\text{arom}}$ ), 7.39 t (2H,  $\text{H}_{\text{arom}}$ ), 7.68 d (1H,  $\text{H}_{\text{arom}}$ ,  $J$  6.9 Hz), 7.74 d (1H,  $\text{H}_{\text{arom}}$ ,  $J$  7.5 Hz), 7.90 d (1H,  $\text{H}_{\text{arom}}$ ,  $J$  7.6 Hz), 9.58 s (1H, NH). Mass spectrum,  $m/z$  ( $I_{\text{rel}}$ , %):  $[M]^+$  455 (18), 248 (100), 207 (13), 192 (16). Found, %: C 76.79; H 6.65; N 3.00.  $\text{C}_{29}\text{H}_{29}\text{NO}_4$ . Calculated, %: C 76.75; H 6.61; N 2.98.

**4-(11-Oxo-7,8,9,10,11,12-hexahydrobenzo[*a*]-acridin-12-yl)-2-ethoxyphenyl isocaproate (Vf).** Yield 52%, colorless crystals, mp 257°C. IR spectrum,  $\text{cm}^{-1}$ : 3267, 3180, 3076, 2980, 1763, 1594, 1523, 1472, 1395, 1270, 1193, 1189, 1132, 1110, 990, 830.  $^1\text{H}$ NMR spectrum,  $\delta$ , ppm: 1.29 t (3H,  $\text{MeCH}_2\text{O}$ ), 3.90 q (2H,  $\text{MeCH}_2\text{O}$ ), 1.00 d [6H,  $\text{OCOCH}_2(\text{CH})\text{Me}_2$ ,  $J$  7.0 Hz], 1.60 m [2H,  $\text{OCOCH}_2(\text{CH})\text{Me}_2$ ], 2.70 m [1H,  $\text{OCOCH}_2(\text{CH})\text{Me}_2$ ], 1.98 m (2H,  $\text{CH}_2$ ), 2.20 m (2H,  $\text{CH}_2$ ), 2.59 m (2H,  $\text{CH}_2$ ), 5.89 s (1H, CH), 6.50 d (1H,  $\text{H}_{\text{arom}}$ ,  $J$  7.9 Hz), 6.64 d (1H,  $\text{H}_{\text{arom}}$ ,  $J$  7.8 Hz), 7.10 s (1H,  $\text{H}_{\text{arom}}$ ), 7.30 m (1H,  $\text{H}_{\text{arom}}$ ), 7.39 t (2H,  $\text{H}_{\text{arom}}$ ), 7.68 d (1H,  $\text{H}_{\text{arom}}$ ,  $J$  6.9 Hz), 7.75 d (1H,  $\text{H}_{\text{arom}}$ ,  $J$  7.8 Hz), 7.90 d (1H,  $\text{H}_{\text{arom}}$ ,  $J$  7.9 Hz), 9.49 s (1H, NH). Mass spectrum,  $m/z$  ( $I_{\text{rel}}$ , %):  $[M]^+$  469 (15), 248 (100), 221 (10), 192 (18). Found, %: C 78.46; H 6.73; N 3.07.  $\text{C}_{30}\text{H}_{31}\text{NO}_4$ . Calculated, %: C 78.43; H 6.75; N 3.05.

**4-(11-Oxo-7,8,9,10,11,12-hexahydrobenzo[*a*]-acridin-12-yl)-2-ethoxyphenyl benzoate (Vg).** Yield 74%, colorless crystals, mp 286°C. IR spectrum,  $\text{cm}^{-1}$ : 3275, 3180, 3084, 2992, 1768, 1608, 1534, 1476, 1398, 1276, 1198, 1196, 1137, 1117, 998, 833.  $^1\text{H}$ NMR spectrum,  $\delta$ , ppm: 1.25 t (3H,  $\text{MeCH}_2\text{O}$ ), 4.00 q (2H,  $\text{MeCH}_2\text{O}$ ), 2.00 m (2H,  $\text{CH}_2$ ), 2.28 m (2H,  $\text{CH}_2$ ), 2.67 m (2H,  $\text{CH}_2$ ), 5.90 s (1H, CH), 6.59 d (1H,  $\text{H}_{\text{arom}}$ ,  $J$  7.3 Hz), 6.80 d (1H,  $\text{H}_{\text{arom}}$ ,  $J$  7.8 Hz), 7.19 s (1H,  $\text{H}_{\text{arom}}$ ), 7.25, 7.40, 7.50 m (5H,  $\text{H}_{\text{arom}}$ ), 7.60, 7.70, 7.74 m (3H,  $\text{H}_{\text{arom}}$ ), 7.93 d (1H,  $\text{H}_{\text{arom}}$ ,  $J$  6.9 Hz), 8.09 m (2H,  $\text{H}_{\text{arom}}$ ), 9.49 s (1H, NH). Mass spectrum,  $m/z$  ( $I_{\text{rel}}$ , %):  $[M]^+$  489 (20), 248 (100), 241 (7), 192 (18). Found, %: C 78.50; H 5.54; N 2.87;  $\text{C}_{32}\text{H}_{27}\text{NO}_4$ . Calculated, %: C 78.53; H 5.52; N 2.86.

**4-(9,9-Dimethyl-11-oxo-7,8,9,10,11,12-hexahydrobenzo[*a*]-acridin-12-yl)-2-ethoxyphenyl carbonylates VIa–VIg.** To a solution of 1.43 g (0.01 mol) of

2-naphthylamine (**I**) in 50 ml of ethanol was added 1.40 g (0.01 mol) of dimedone (**IIIb**), 0.01 mol of ester **IIa–IIg**. The mixture was heated at reflux for 2–3 h depending on the length of the acid rest in the vanillal ester. On cooling the reaction mixture the crystalline precipitate was separated, washed with hot methanol, and recrystallized from benzene.

**4-(9,9-Dimethyl-11-oxo-7,8,9,10,11,12-hexahydrobenzo[*a*]-acridin-12-yl)-2-ethoxyphenyl formate (VIa).** Yield 84%, colorless crystals, mp 275°C. IR spectrum,  $\text{cm}^{-1}$ : 3260, 3184, 3086, 2978, 1754, 1608, 1524, 1493, 1466, 1387, 1262, 1194, 1181, 1133, 1120, 1098, 979, 820.  $^1\text{H}$ NMR spectrum,  $\delta$ , ppm: 0.90 s (3H, Me), 1.20 s (3H, Me), 1.30 t (3H,  $\text{MeCH}_2\text{O}$ ), 3.92 q (2H,  $\text{MeCH}_2\text{O}$ ), 8.20 s (1H, OCOH), 2.02 m (2H,  $\text{CH}_2$ ), 2.40 m (2H,  $\text{CH}_2$ ), 5.70 s (1H, CH), 6.45 d (1H,  $\text{H}_{\text{arom}}$ ,  $J$  7.9 Hz), 6.70 s (1H,  $\text{H}_{\text{arom}}$ ), 7.25–7.40 m (3H,  $\text{H}_{\text{arom}}$ ), 7.60–7.70 m (3H,  $\text{H}_{\text{arom}}$ ), 7.94 d (1H,  $\text{H}_{\text{arom}}$ ,  $J$  7.5 Hz), 9.50 s (1H, NH). Mass spectrum,  $m/z$  ( $I_{\text{rel}}$ , %):  $[M]^+$  441 (15), 276 (100), 192 (22), 165 (17). Found, %: C 76.17; H 6.10; N 3.19.  $\text{C}_{28}\text{H}_{27}\text{NO}_4$ . Calculated, %: C 76.19; H 6.12; N 3.17.

**4-(9,9-Dimethyl-11-oxo-7,8,9,10,11,12-hexahydrobenzo[*a*]-acridin-12-yl)-2-ethoxyphenyl acetate (VIb).** Yield 93%, colorless crystals, mp 244°C. IR spectrum,  $\text{cm}^{-1}$ : 3264, 3189, 3080, 2979, 1754, 1600, 1531, 1499, 1467, 1392, 1261, 1187, 1186, 1137, 1125, 1096, 976, 830.  $^1\text{H}$ NMR spectrum,  $\delta$ , ppm: 0.90 s (3H, Me), 1.22 s (3H, Me), 1.34 t (3H,  $\text{MeCH}_2\text{O}$ ), 3.90 q (2H,  $\text{MeCH}_2\text{O}$ ), 2.15 s (3H, OCOMe), 1.90 m (2H,  $\text{CH}_2$ ), 2.28 m (2H,  $\text{CH}_2$ ), 5.94 s (1H, CH), 6.55 d (1H,  $\text{H}_{\text{arom}}$ ,  $J$  7.2 Hz), 6.60 d (1H,  $\text{H}_{\text{arom}}$ ,  $J$  7.0 Hz), 7.12 C (1H,  $\text{H}_{\text{arom}}$ ), 7.28 m (2H,  $\text{H}_{\text{arom}}$ ), 7.40 t (1H,  $\text{H}_{\text{arom}}$ ), 7.70 d (1H,  $\text{H}_{\text{arom}}$ ,  $J$  6.9 Hz), 7.76 d (1H,  $\text{H}_{\text{arom}}$ ,  $J$  6.8 Hz), 7.90 d (1H,  $\text{H}_{\text{arom}}$ ,  $J$  6.8 Hz), 9.45 s (1H, NH). Mass spectrum,  $m/z$  ( $I_{\text{rel}}$ , %):  $[M]^+$  455 (19), 276 (100), 192 (20), 179 (28). Found, %: C 76.46; H 6.39; N 3.07.  $\text{C}_{29}\text{H}_{29}\text{NO}_4$ . Calculated, %: C 76.48; H 6.37; N 3.08.

**4-(9,9-Dimethyl-11-oxo-7,8,9,10,11,12-hexahydrobenzo[*a*]-acridin-12-yl)-2-ethoxyphenyl propionate (VIc).** Yield 90%, colorless crystals, mp 270°C. IR spectrum,  $\text{cm}^{-1}$ : 3260, 3190, 3075, 2975, 1756, 1603, 1534, 1497, 1460, 1387, 1254, 1181, 1134, 1122, 1091, 974, 832.  $^1\text{H}$ NMR spectrum,  $\delta$ , ppm: 0.95 s (3H, Me), 1.20 s (3H, Me), 1.30 t (3H,  $\text{MeCH}_2\text{O}$ ), 3.96 q (2H,  $\text{MeCH}_2\text{O}$ ), 1.17 t (3H,  $\text{OCOCH}_2\text{Me}$ ), 1.29 q (2H,  $\text{OCOCH}_2\text{Me}$ ), 1.95 m (2H,  $\text{CH}_2$ ), 2.29 m (2H,  $\text{CH}_2$ ), 5.90 s (1H, CH), 6.47 d (1H,  $\text{H}_{\text{arom}}$ ,  $J$  7.4 Hz), 6.56 d (1H,  $\text{H}_{\text{arom}}$ ,  $J$  7.0 Hz), 7.10 s (1H,  $\text{H}_{\text{arom}}$ ), 7.30 m (2H,

$H_{\text{arom}}$ ), 7.40 t (1H,  $H_{\text{arom}}$ ), 7.68 d (1H,  $H_{\text{arom}}$ ,  $J$  7.0 Hz), 7.75 d (1H,  $H_{\text{arom}}$ ,  $J$  6.4 Hz), 7.90 d (1H,  $H_{\text{arom}}$ ,  $J$  7.2 Hz), 9.50 s (1H, NH). Mass spectrum,  $m/z$  ( $I_{\text{rel}}$ , %):  $[M]^+$  469 (22), 276 (100), 192 (22), 193 (25). Found, %: C 76.75; H 6.60; N 2.99.  $C_{30}H_{31}NO_4$ . Calculated, %: C 76.76; H 6.61; N 2.98.

**4-(9,9-Dimethyl-11-oxo-7,8,9,10,11,12-hexahydrobenzo[*a*]acridin-12-yl)-2-ethoxyphenyl butyrate (VIId).** Yield 72%, colorless crystals, mp 230°C. IR spectrum,  $cm^{-1}$ : 3264, 3187, 3075, 2975, 1756, 1607, 1538, 1489, 1463, 1388, 1256, 1178, 1133, 1127, 1095, 970, 837.  $^1H$  NMR spectrum,  $\delta$ , ppm: 0.93 s (3H, Me), 1.18 s (3H, Me), 1.28 t (3H,  $\underline{MeCH_2O}$ ), 3.98 q (2H,  $\underline{MeCH_2O}$ ), 1.00 t [3H,  $\underline{OCO(CH_2)_2Me}$ ], 1.65 m (2H,  $\underline{OCOCH_2CH_2Me}$ ), 2.67 m (2H,  $\underline{OCOCH_2CH_2Me}$ ), 2.10 m (2H,  $CH_2$ ), 2.40 m (2H,  $CH_2$ ), 5.88 s (1H, CH), 6.50 d (1H,  $H_{\text{arom}}$ ,  $J$  7.4 Hz), 6.65 d (1H,  $H_{\text{arom}}$ ,  $J$  7.0 Hz), 7.16 s (1H,  $H_{\text{arom}}$ ), 7.27 m (2H,  $H_{\text{arom}}$ ), 7.38 t (1H,  $H_{\text{arom}}$ ), 7.68 d (1H,  $H_{\text{arom}}$ ,  $J$  6.9 Hz), 7.77 d (1H,  $H_{\text{arom}}$ ,  $J$  7.6 Hz), 7.95 d (1H,  $H_{\text{arom}}$ ,  $J$  7.6 Hz), 9.45 s (1H, NH). Mass spectrum,  $m/z$  ( $I_{\text{rel}}$ , %):  $[M]^+$  483 (19), 276 (100), 207 (23), 192 (24). Found, %: C 77.03; H 6.81; N 2.94.  $C_{31}H_{33}NO_4$ . Calculated, %: C 77.01; H 6.83; N 2.90.

**4-(9,9-Dimethyl-11-oxo-7,8,9,10,11,12-hexahydrobenzo[*a*]acridin-12-yl)-2-ethoxyphenyl isobutyrate (VIe).** Yield 65%, colorless crystals, mp 260°C. IR spectrum,  $cm^{-1}$ : 3267, 3181, 3072, 2970, 1756, 1602, 1534, 1492, 1470, 1388, 1255, 1174, 1138, 1122, 1093, 972, 836.  $^1H$  NMR spectrum,  $\delta$ , ppm: 0.98 s (3H, Me), 1.10 s (3H, Me), 1.30 t (3H,  $\underline{MeCH_2O}$ ), 3.90 q (2H,  $\underline{MeCH_2O}$ ), 1.20 d (6H,  $\underline{OCOCHMe_2}$ ,  $J$  7.0 Hz), 2.70 m (1H,  $\underline{OCOCHMe_2}$ ), 1.99 m (2H,  $CH_2$ ), 2.30 m (2H,  $CH_2$ ), 5.85 s (1H, CH), 6.50 d (1H,  $H_{\text{arom}}$ ,  $J$  7.8 Hz), 6.65 d (1H,  $H_{\text{arom}}$ ,  $J$  7.0 Hz), 7.09 s (1H,  $H_{\text{arom}}$ ), 7.28 m (2H,  $H_{\text{arom}}$ ), 7.40 m (2H,  $H_{\text{arom}}$ ), 7.69 d (1H,  $H_{\text{arom}}$ ,  $J$  7.2 Hz), 7.74 d (1H,  $H_{\text{arom}}$ ,  $J$  7.5 Hz), 7.95 d (1H,  $H_{\text{arom}}$ ,  $J$  7.8 Hz), 9.40 s (1H, NH). Mass spectrum,  $m/z$  ( $I_{\text{rel}}$ , %):  $[M]^+$  483 (20), 276 (100), 207 (19), 192 (17). Found, %: C 77.00; H 6.80; N 2.95.  $C_{31}H_{33}NO_4$ . Calculated, %: C 77.01; H 6.83; N 2.90.

**4-(9,9-Dimethyl-11-oxo-7,8,9,10,11,12-hexahydrobenzo[*a*]acridin-12-yl)-2-ethoxyphenyl isovalerate (VIIf).** Yield 60%, colorless crystals, mp 256°C. IR spectrum,  $cm^{-1}$ : 3264, 3179, 3067, 2979, 1752, 1604, 1538, 1497, 1476, 1391, 1261, 1172, 1132, 1126, 1087, 976, 832.  $^1H$  NMR spectrum,  $\delta$ , ppm: 0.99 s (3H, Me), 1.06 s (3H, Me), 1.28 t (3H,  $\underline{MeCH_2O}$ ), 3.75 q (2H,  $\underline{MeCH_2O}$ ), 1.05 d [6H,  $\underline{OCOCH_2(CH)Me_2}$ ,  $J$  7.4 Hz], 1.65 m [2H,  $\underline{OCOCH_2(CH)(Me)_2}$ ], 2.73 m [1H,

$\underline{OCOCH_2(CH)Me_2}$ ], 1.97 m (2H,  $CH_2$ ), 2.20 m (2H,  $CH_2$ ), 5.87 s (1H, CH), 6.50 d (1H,  $H_{\text{arom}}$ ,  $J$  7.9 Hz), 6.67 d (1H,  $H_{\text{arom}}$ ,  $J$  7.8 Hz), 7.15 s (1H,  $H_{\text{arom}}$ ), 7.28 m (1H,  $H_{\text{arom}}$ ), 7.39 t (2H,  $H_{\text{arom}}$ ), 7.64 d (1H,  $H_{\text{arom}}$ ,  $J$  6.9 Hz), 7.73 d (1H,  $H_{\text{arom}}$ ,  $J$  7.8 Hz), 7.90 d (1H,  $H_{\text{arom}}$ ,  $J$  7.9 Hz), 9.53 s (1H, NH). Mass spectrum,  $m/z$  ( $I_{\text{rel}}$ , %):  $[M]^+$  497 (21), 276 (100), 221 (19), 192 (23). Found, %: C 77.26; H 7.03; N 2.85.  $C_{32}H_{35}NO_4$ . Calculated, %: C 77.26; H 7.04; N 2.82.

**4-(9,9-Dimethyl-11-oxo-7,8,9,10,11,12-hexahydrobenzo[*a*]acridin-12-yl)-2-ethoxyphenyl benzoate (VIg).** Yield 85%, colorless crystals, mp 282°C. IR spectrum,  $cm^{-1}$ : 3262, 3184, 3063, 2977, 1754, 1610, 1532, 1501, 1470, 1394, 1268, 1176, 1132, 1122, 1091, 972, 830.  $^1H$  NMR spectrum,  $\delta$ , ppm: 0.90 s (3H, Me), 1.10 s (3H, Me), 1.28 t (3H,  $\underline{MeCH_2O}$ ), 4.00 q (2H,  $\underline{MeCH_2O}$ ), 2.15 m (2H,  $CH_2$ ), 2.60 m (2H,  $CH_2$ ), 5.90 s (1H, CH), 6.60 d (1H,  $H_{\text{arom}}$ ,  $J$  7.6 Hz), 6.80 d (1H,  $H_{\text{arom}}$ ,  $J$  7.5 Hz), 7.15 s (1H,  $H_{\text{arom}}$ ), 7.30, 7.40, 7.50 m (5H,  $H_{\text{arom}}$ ), 7.65 m (1H,  $H_{\text{arom}}$ ), 7.75 m (2H,  $H_{\text{arom}}$ ), 7.90 d (1H,  $H_{\text{arom}}$ ,  $J$  7.9 Hz), 8.10 m (2H,  $H_{\text{arom}}$ ), 9.40 s (1H, NH). Mass spectrum,  $m/z$  ( $I_{\text{rel}}$ , %):  $[M]^+$  517 (22), 248 (100), 241 (17), 192 (23). Found, %: C 78.95; H 5.98; N 2.69.  $C_{34}H_{31}NO_4$ . Calculated, %: C 78.92; H 6.00; N 2.71.

**4-(11-Oxo-9-phenyl-7,8,9,10,11,12-hexahydrobenzo[*a*]acridin-12-yl)-2-ethoxyphenyl carboxylates VIIa–VIIg.** To a solution of 1.43 g (0.01 mol) of 2-naphthylamine (**I**) in 50 ml of butanol was added 1.88 g (0.01 mol) of 5-phenyl-1,3-cyclohexanedione (**IIIc**), and 0.01 mol of ester **IIa–IIg**, and the mixture was heated at reflux for 1–3 h depending on the length of the acid rest in the vanillal ester. On cooling the reaction mixture the crystalline precipitate was separated, washed with ether, and recrystallized from a mixture alcohol–benzene, 1:3.

**4-(11-Oxo-9-phenyl-7,8,9,10,11,12-hexahydrobenzo[*a*]acridin-12-yl)-2-ethoxyphenyl formate (VIIa).** Yield 63%, colorless crystals, mp 242°C. IR spectrum,  $cm^{-1}$ : 3270, 3190, 2957, 1757, 1600, 1584, 1520, 1497, 1469, 1425, 1400, 1386, 1261, 1242, 1184, 1153, 1119, 1098, 819, 744.  $^1H$  NMR spectrum,  $\delta$ , ppm: 8.10 s (1H, COCOH), 2.58 m (2H,  $C^{\delta}H_2$ ), 2.90 m (2H,  $C^{10}H_2$ ), 6.03 m (1H,  $H_{\text{arom}}$ ), 6.15 m (1H,  $H_{\text{arom}}$ ), 7.10–7.20, 7.25–7.35, 7.37–7.43 m (9H,  $H_{\text{arom}}$ ), 7.45 d (1H,  $H_{\text{arom}}$ ,  $J$  7.4 Hz), 7.78–7.85 m (2H,  $H_{\text{arom}}$ ). Mass spectrum,  $m/z$  ( $I_{\text{rel}}$ , %):  $[M]^+$  489 (70), 324 (100), 192 (10). **Isomer C<sup>9</sup>-Ph<sub>a</sub>**,  $\delta$ , ppm: 1.28 t (3H,  $\underline{MeCH_2O}$ ), 3.96 q (2H,  $\underline{MeCH_2O}$ ), 3.39 m (1H,  $H^{\beta}$ ), 5.84 s (1H,  $H^{12}$ ), 9.40 s (1H, NH). **Isomer C<sup>9</sup>-Ph<sub>e</sub>**,  $\delta$ , ppm: 1.24 t (3H,



$\text{MeCH}_2\text{O}$ ), 3.90 q (2H,  $\text{MeCH}_2\text{O}$ ), 3.28 m (1H,  $\text{H}_a^9$ ), 5.92 s (1H,  $\text{H}^{12}$ ), 9.52 s (1H, NH). Found, %: C 78.51; H 5.54; N 2.83.  $\text{C}_{32}\text{H}_{27}\text{NO}_4$ . Calculated, %: C 78.53; H 5.52; N 2.86.

**4-(11-Oxo-9-phenyl-7,8,9,10,11,12-hexahydrobenzo[*a*]acridin-12-yl)-2-ethoxyphenyl acetate (VII b).** Yield 70%, colorless crystals, mp 257°C. IR spectrum,  $\text{cm}^{-1}$ : 3273, 3189, 2952, 1754, 1603, 1586, 1520, 1493, 1467, 1421, 1405, 1386, 1261, 1244, 1188, 1153, 1123, 1098, 821, 745.  $^1\text{H}$ NMR spectrum,  $\delta$ , ppm: 2.19 s (3H,  $\text{OCOMe}$ ), 2.64 m (2H,  $\text{C}^8\text{H}_2$ ), 2.89 m (2H,  $\text{C}^{10}\text{H}_2$ ), 6.60 m (1H,  $\text{H}_{\text{arom}}$ ), 6.80 m (1H,  $\text{H}_{\text{arom}}$ ), 7.10–7.28 m (2H,  $\text{H}_{\text{arom}}$ ), 7.30–7.50 m (7H,  $\text{H}_{\text{arom}}$ ), 7.80 m (2H,  $\text{H}_{\text{arom}}$ ), 8.00 d (1H,  $\text{H}_{\text{arom}}$ ,  $J$  7.6 Hz). Mass spectrum,  $m/z$  ( $I_{\text{rel}}$ , %):  $[M]^+$  503 (18), 324 (85), 192 (27), 78 (25), 43 (100). **Isomer  $\text{C}^9\text{-Ph}_a$** ,  $\delta$ , ppm: 1.26 t (3H,  $\text{MeCH}_2\text{O}$ ), 4.00 q (2H,  $\text{MeCH}_2\text{O}$ ), 3.35 m (1H,  $\text{H}_a^9$ ), 5.83 s (1H,  $\text{H}^{12}$ ), 9.80 s (1H, NH). **Isomer  $\text{C}^9\text{-Ph}_e$** ,  $\delta$ , ppm: 1.23 t (3H,  $\text{MeCH}_2\text{O}$ ), 3.90 q (2H,  $\text{MeCH}_2\text{O}$ ), 3.28 m (1H,  $\text{H}_a^9$ ), 5.90 s (1H,  $\text{H}^{12}$ ), 9.90 s (1H, NH). Found, %: C 78.70; H 5.77; N 2.79.  $\text{C}_{33}\text{H}_{29}\text{NO}_4$ . Calculated, %: C 78.72; H 5.76; N 2.78.

**4-(11-Oxo-9-phenyl-7,8,9,10,11,12-hexahydrobenzo[*a*]acridin-12-yl)-2-ethoxyphenyl propionate (VIIc).** Yield 65%, colorless crystals, mp 262°C. IR spectrum,  $\text{cm}^{-1}$ : 3276, 3185, 2952, 1755, 1600, 1584, 1518, 1495, 1468, 1418, 1411, 1386, 1254, 1242, 1183, 1151, 1127, 1092, 820, 743.  $^1\text{H}$ NMR spectrum,  $\delta$ , ppm: 1.17 t (3H,  $\text{OCOCH}_2\text{Me}$ ), 1.25 q (2H,  $\text{OCOCH}_2\text{Me}$ ), 2.59 m (2H,  $\text{C}^8\text{H}_2$ ), 2.90 m (2H,  $\text{C}^{10}\text{H}_2$ ), 6.04 m (1H,  $\text{H}_{\text{arom}}$ ), 6.10 m (1H,  $\text{H}_{\text{arom}}$ ), 7.10–7.15, 7.20–7.30, 7.35–7.44 m (9H,  $\text{H}_{\text{arom}}$ ), 7.48 d (1H,  $\text{H}_{\text{arom}}$ ,  $J$  7.0 Hz) 7.76–7.82 m (2H,  $\text{H}_{\text{arom}}$ ). Mass spectrum,  $m/z$  ( $I_{\text{rel}}$ , %):  $[M]^+$  517 (20), 324 (70), 192 (30), 62 (100). **Isomer  $\text{C}^9\text{-Ph}_a$** ,  $\delta$ , ppm: 1.28 t (3H,  $\text{MeCH}_2\text{O}$ ), 3.92 q (2H,  $\text{MeCH}_2\text{O}$ ), 3.38 m (1H,  $\text{H}_a^9$ ), 5.90 s (1H,  $\text{H}^{12}$ ), 9.45 s (1H, NH). **Isomer  $\text{C}^9\text{-Ph}_e$** ,  $\delta$ , ppm: 1.25 t (3H,  $\text{MeCH}_2\text{O}$ ), 3.88 q (2H,  $\text{MeCH}_2\text{O}$ ), 3.28 m (1H,  $\text{C}^9\text{H}_a^9$ ), 5.94 s (1H,  $\text{H}^{12}$ ), 9.50 s (1H, NH). Found, %: C 78.94; H 5.96; N 2.70.  $\text{C}_{34}\text{H}_{31}\text{NO}_4$ . Calculated, %: C 78.92; H 5.99; N 2.71.

**4-(11-Oxo-9-phenyl-7,8,9,10,11,12-hexahydrobenzo[*a*]acridin-12-yl)-2-ethoxyphenyl butyrate (VII d).** Yield 62%, colorless crystals, mp 260°C. IR spectrum,  $\text{cm}^{-1}$ : 3275, 3183, 2956, 1757, 1603, 1582, 1511, 1499, 1471, 1420, 1414, 1381, 1252, 1244, 1183, 1152, 1126, 1090, 824, 747.  $^1\text{H}$ NMR spectrum,  $\delta$ , ppm: 1.00 t [3H,  $\text{OCO}(\text{CH}_2)_2\text{Me}$ ], 1.62 m (2H,  $\text{OCOCH}_2\text{CH}_2\text{Me}$ ), 2.69 m (2H,  $\text{OCOCH}_2\text{-CH}_2\text{Me}$ ), 2.60 m (2H,  $\text{C}^8\text{H}_2$ ), 2.80 m (2H,  $\text{C}^{10}\text{H}_2$ ), 6.04 m (1H,  $\text{H}_{\text{arom}}$ ), 6.15 m (1H,

$\text{H}_{\text{arom}}$ ), 7.06–7.12, 7.25–7.35, 7.37–7.45 m (9H,  $\text{H}_{\text{arom}}$ ), 7.48 d (1H,  $\text{H}_{\text{arom}}$ ,  $J$  7.0 Hz) 7.79–7.85 m (2H,  $\text{H}_{\text{arom}}$ ). Mass spectrum,  $m/z$  ( $I_{\text{rel}}$ , %):  $[M]^+$  531 (24), 324 (80), 192 (18), 76 (100). **Isomer  $\text{C}^9\text{-Ph}_a$** ,  $\delta$ , ppm: 1.30 t (3H,  $\text{MeCH}_2\text{O}$ ), 4.00 q (2H,  $\text{MeCH}_2\text{O}$ ), 3.45 m (1H,  $\text{H}_a^9$ ), 5.90 s (1H,  $\text{H}^{12}$ ), 9.45 s (1H, NH). **Isomer  $\text{C}^9\text{-Ph}_e$** ,  $\delta$ , ppm: 1.26 t (3H,  $\text{MeCH}_2\text{O}$ ), 3.90 q (2H,  $\text{MeCH}_2\text{O}$ ), 3.30 m (1H,  $\text{H}_a^9$ ), 5.95 s (1H,  $\text{H}^{12}$ ), 9.55 s (1H, NH). Found, %: C 79.10; H 6.25; N 2.61.  $\text{C}_{35}\text{H}_{33}\text{NO}_4$ . Calculated, %: C 79.09; H 6.21; N 2.63.

**4-(11-Oxo-9-phenyl-7,8,9,10,11,12-hexahydrobenzo[*a*]acridin-12-yl)-2-ethoxyphenyl isobutyrate (VIIe).** Yield 58%, colorless crystals, mp 253°C. IR spectrum,  $\text{cm}^{-1}$ : 3275, 3183, 2956, 1752, 1600, 1582, 1522, 1492, 1469, 1420, 1417, 1388, 1291, 1242, 1185, 1150, 1119, 1091, 819, 744.  $^1\text{H}$ NMR spectrum,  $\delta$ , ppm: 1.16 d [6H,  $\text{OCOCHMe}_2$ ,  $J$  7.0 Hz], 2.67 m [1H,  $\text{OCOCHMe}_2$ ], 2.64 m (2H,  $\text{C}^8\text{H}_2$ ), 2.80 m (2H,  $\text{C}^{10}\text{H}_2$ ), 6.02 m (1H,  $\text{H}_{\text{arom}}$ ), 6.15 m (1H,  $\text{H}_{\text{arom}}$ ), 7.02–7.10, 7.25–7.35, 7.35–7.48 m (9H,  $\text{H}_{\text{arom}}$ ), 7.50 d (1H,  $\text{H}_{\text{arom}}$ ,  $J$  7.2 Hz), 7.73–7.76 m (2H,  $\text{H}_{\text{arom}}$ ). Mass spectrum,  $m/z$  ( $I_{\text{rel}}$ , %):  $[M]^+$  531 (14), 324 (100), 192 (16), 76 (77). **Isomer  $\text{C}^9\text{-Ph}_a$** ,  $\delta$ , ppm: 1.29 t (3H,  $\text{MeCH}_2\text{O}$ ), 3.97 q (2H,  $\text{MeCH}_2\text{O}$ ), 3.34 m (1H,  $\text{H}_a^9$ ), 5.90 s (1H,  $\text{H}^{12}$ ), 9.48 s (1H, NH). **Isomer  $\text{C}^9\text{-Ph}_e$** ,  $\delta$ , ppm: 1.25 t (3H,  $\text{MeCH}_2\text{O}$ ), 3.92 q (2H,  $\text{MeCH}_2\text{O}$ ), 3.28 m (1H,  $\text{H}_a^9$ ), 5.95 s (1H,  $\text{H}^{12}$ ), 9.53 s (1H, NH). Found, %: C 79.07; H 6.20; N 2.64.  $\text{C}_{35}\text{H}_{33}\text{NO}_4$ . Calculated, %: C 79.09; H 6.21; N 2.63.

**4-(11-Oxo-9-phenyl-7,8,9,10,11,12-hexahydrobenzo[*a*]acridin-12-yl)-2-ethoxyphenyl isovalerate (VII f).** Yield 46%, colorless crystals, mp 259°C. IR spectrum,  $\text{cm}^{-1}$ : 3271, 3186, 2952, 1754, 1600, 1581, 1514, 1489, 1471, 1426, 1422, 1389, 1253, 1242, 1187, 1153, 1131, 1094, 822, 743.  $^1\text{H}$ NMR spectrum,  $\delta$ , ppm: 0.98 d [6H,  $\text{OCOCH}_2(\text{CH})\text{Me}_2$ ,  $J$  7.8 Hz], 2.30 m [2H,  $\text{OCOCH}_2(\text{CH})\text{-Me}_2$ ], 2.58 m [1H,  $\text{OCOCH}_2(\text{CH})\text{Me}_2$ ], 2.76 m (2H,  $\text{C}^8\text{H}_2$ ), 2.94 m (2H,  $\text{C}^{10}\text{H}_2$ ), 6.54 m (1H,  $\text{H}_{\text{arom}}$ ), 6.13 m (1H,  $\text{H}_{\text{arom}}$ ), 7.00–7.13, 7.24–7.30, 7.33–7.49 m (9H,  $\text{H}_{\text{arom}}$ ), 7.81–7.84 m (2H,  $\text{H}_{\text{arom}}$ ), 8.00 (1H,  $\text{H}_{\text{arom}}$ ,  $J$  7.2 Hz). Mass spectrum,  $m/z$  ( $I_{\text{rel}}$ , %):  $[M]^+$  545 (9), 324 (100), 122 (11), 78 (80). **Isomer  $\text{C}^9\text{-Ph}_a$** ,  $\delta$ , ppm: 1.24 t (3H,  $\text{MeCH}_2\text{O}$ ), 3.90 q (2H,  $\text{MeCH}_2\text{O}$ ), 3.31 m (1H,  $\text{H}_a^9$ ), 5.89 s (1H,  $\text{H}^{12}$ ), 9.80 s (1H, NH). **Isomer  $\text{C}^9\text{-Ph}_e$** ,  $\delta$ , ppm: 1.18 t (3H,  $\text{MeCH}_2\text{O}$ ), 3.80 q (2H,  $\text{MeCH}_2\text{O}$ ), 3.26 m (1H,  $\text{H}_a^9$ ), 5.92 s (1H,  $\text{H}^{12}$ ), 9.84 s (1H, NH). Found, %: C 79.29; H 6.44; N 2.55.  $\text{C}_{36}\text{H}_{35}\text{NO}_4$ . Calculated, %: C 79.27; H 6.42; N 2.57.

**4-(11-Oxo-9-phenyl-7,8,9,10,11,12-hexahydrobenzo[*a*]acridin-12-yl)-2-ethoxyphenyl benzoate**



**(VIIg).** Yield 45%, colorless crystals, mp 267°C. IR spectrum,  $\text{cm}^{-1}$ : 3274, 3182, 2952, 1754, 1600, 1585, 1511, 1489, 1478, 1422, 1420, 1381, 1258, 1241, 1186, 1150, 1134, 1092, 827, 746.  $^1\text{H}$  NMR spectrum,  $\delta$ , ppm: 6.65 m (1H,  $\text{H}_{\text{arom}}$ ), 6.90 m (1H,  $\text{H}_{\text{arom}}$ ), 7.10–7.45, 7.58, 7.70, 7.86 m (14H,  $\text{H}_{\text{arom}}$ ), 8.05 m (3H,  $\text{H}_{\text{arom}}$ ). Mass spectrum,  $m/z$  ( $I_{\text{rel}}$ , %):  $[M]^+$  565 (84), 324 (68), 192 (23), 105 (100), 77 (55). **Isomer C<sup>9</sup>-Ph<sub>a</sub>**,  $\delta$ , ppm: 1.30 t (3H,  $\text{MeCH}_2\text{O}$ ), 4.08 q (2H,  $\text{MeCH}_2\text{O}$ ), 3.31 m (1H,  $\text{H}_a^9$ ), 5.89 s (1H,  $\text{H}^{12}$ ), 9.80 s (1H, NH). **Isomer C<sup>9</sup>-Ph<sub>e</sub>**,  $\delta$ , ppm: 1.28 t (3H,  $\text{MeCH}_2\text{O}$ ), 3.97 q (2H,  $\text{MeCH}_2\text{O}$ ), 3.26 m (1H,  $\text{H}_a^9$ ), 5.93 s (1H,  $\text{H}^{12}$ ), 9.90 s (1H, NH). Found, %: C 83.64; H 5.51; N 2.47.  $\text{C}_{38}\text{H}_{31}\text{NO}_4$ . Calculated, %: C 83.67; H 5.49; N 2.48.

**4-(12-Oxo-12H-benzo[f]indeno[1,2-b]-quinolin-13-yl)-2-ethoxyphenyl carboxylates IXa–IXg.** To a solution of 1.46 g (0.01 mol) of 1,3-indanedione (**IV**) in 10 ml of alcohol was added a solution of 1.43 g (0.01 mol) of 2-naphthylamine (**I**) in 10 ml of alcohol and a solution of 0.01 mol of an appropriate ester **IIa–IIg** in 10 ml of alcohol. The reaction mixture was heated at reflux for 30–60 min. On cooling the formed precipitate was separated, 15 ml of nitrobenzene was added, and the solution was boiled for 3–4 h. The solvent was evaporated, the solid residue was washed with ether and crystallized from a mixture ethanol–benzene, 1: 3.

**4-(12-Oxo-12H-benzo[f]indeno[1,2-b]-quinolin-13-yl)-2-ethoxyphenyl formate (IXa).** Yield 52%, yellow crystals, mp 263°C. IR spectrum,  $\text{cm}^{-1}$ : 3052, 2975, 1762, 1700, 1563, 1506, 1334, 1245, 1143, 1112, 1039, 843, 704.  $^1\text{H}$  NMR spectrum,  $\delta$ , ppm: 1.30 t (3H,  $\text{MeCH}_2\text{O}$ ), 3.95 q (2H,  $\text{MeCH}_2\text{O}$ ), 8.15 s (1H, OCOH), 6.90 d (1H,  $\text{H}_{\text{arom}}$ ,  $J$  7.6 Hz), 7.05 s (1H,  $\text{H}_{\text{arom}}$ ), 7.20 m (2H,  $\text{H}_{\text{arom}}$ ), 7.50, 7.65, 7.70 m (5H,  $\text{H}_{\text{arom}}$ ), 7.90 d (1H,  $\text{H}_{\text{arom}}$ ,  $J$  7.8 Hz), 8.00–8.15 m (3H,  $\text{H}_{\text{arom}}$ ). Mass spectrum,  $m/z$  ( $I_{\text{rel}}$ , %):  $[M]^+$  445 (100), 280 (40), 165 (24). Found, %: C 78.19; H 4.25; N 3.17.  $\text{C}_{29}\text{H}_{19}\text{NO}_4$ . Calculated, %: C 78.20; H 4.27; N 3.16.

**4-(12-Oxo-12H-benzo[f]indeno[1,2-b]-quinolin-13-yl)-2-ethoxyphenyl acetate (IXb).** Yield 63%, yellow crystals, mp 263°C. IR spectrum,  $\text{cm}^{-1}$ : 3058, 2971, 1768, 1700, 1566, 1508, 1335, 1240, 1147, 1110, 1042, 847, 706.  $^1\text{H}$  NMR spectrum,  $\delta$ , ppm: 1.35 t (3H,  $\text{MeCH}_2\text{O}$ ), 4.00 q (2H,  $\text{MeCH}_2\text{O}$ ), 2.35 s (3H, OCOMe), 6.90 d (1H,  $\text{H}_{\text{arom}}$ ,  $J$  7.6 Hz), 7.10 s (1H,  $\text{H}_{\text{arom}}$ ), 7.22 m (2H,  $\text{H}_{\text{arom}}$ ), 7.50, 7.62, 7.75 m (5H,  $\text{H}_{\text{arom}}$ ), 7.90 d (1H,  $\text{H}_{\text{arom}}$ ,  $J$  7.6 Hz), 8.03–8.10 m (3H,  $\text{H}_{\text{arom}}$ ). Mass spectrum,  $m/z$  ( $I_{\text{rel}}$ , %):  $[M]^+$  459 (100), 280 (43), 179 (20). Found,

%: C 78.46; H 4.54; N 3.00.  $\text{C}_{30}\text{H}_{21}\text{NO}_4$ . Calculated, %: C 78.43; H 4.58; N 3.05.

**4-(12-Oxo-12H-benzo[f]indeno[1,2-b]-quinolin-13-yl)-2-ethoxyphenyl propionate (IXc).** Yield 60%, yellow crystals, mp 250°C. IR spectrum,  $\text{cm}^{-1}$ : 3050, 2970, 1765, 1710, 1566, 1502, 1331, 1245, 1149, 1119, 1033, 842, 702.  $^1\text{H}$  NMR spectrum,  $\delta$ , ppm: 1.30 t (3H,  $\text{MeCH}_2\text{O}$ ), 3.90 q (2H,  $\text{MeCH}_2\text{O}$ ), 1.20 t (3H,  $\text{OCH}_2\text{Me}$ ), 1.26 q (2H,  $\text{OCH}_2\text{Me}$ ), 6.85 d (1H,  $\text{H}_{\text{arom}}$ ,  $J$  7.9 Hz), 7.10 s (1H,  $\text{H}_{\text{arom}}$ ), 7.25 m (2H,  $\text{H}_{\text{arom}}$ ), 7.55, 7.68, 7.79 m (5H,  $\text{H}_{\text{arom}}$ ), 7.98 d (1H,  $\text{H}_{\text{arom}}$ ,  $J$  7.2 Hz), 8.08–8.20 m (3H,  $\text{H}_{\text{arom}}$ ). Mass spectrum,  $m/z$  ( $I_{\text{rel}}$ , %):  $[M]^+$  473 (100), 280 (39), 193 (25). Found, %: C 78.63; H 4.89; N 3.00.  $\text{C}_{31}\text{H}_{23}\text{NO}_4$ . Calculated, %: C 78.65; H 4.87; N 2.95.

**4-(12-Oxo-12H-benzo[f]indeno[1,2-b]-quinolin-13-yl)-2-ethoxyphenyl butyrate (IXd).** Yield 55%, yellow crystals, mp 242°C. IR spectrum,  $\text{cm}^{-1}$ : 3045, 2970, 1763, 1716, 1608, 1566, 1504, 1473, 1382, 1331, 1284, 1241, 1174, 1152, 1119, 1038, 842, 746, 702.  $^1\text{H}$  NMR spectrum,  $\delta$ , ppm: 1.28 t (3H,  $\text{MeCH}_2\text{O}$ ), 3.95 q (2H,  $\text{MeCH}_2\text{O}$ ), 1.00 t [3H,  $\text{OCO}(\text{CH}_2)_2\text{Me}$ ], 1.70 m (2H,  $\text{OCOCH}_2\text{CH}_2\text{Me}$ ), 2.65 m (2H,  $\text{OCOCH}_2\text{CH}_2\text{Me}$ ), 6.88 d (1H,  $\text{H}_{\text{arom}}$ ,  $J$  8.0 Hz), 7.10 s (1H,  $\text{H}_{\text{arom}}$ ), 7.28 m (2H,  $\text{H}_{\text{arom}}$ ), 7.50, 7.68, 7.75 m (5H,  $\text{H}_{\text{arom}}$ ), 7.90 d (1H,  $\text{H}_{\text{arom}}$ ,  $J$  7.2 Hz), 8.11–8.22 m (3H,  $\text{H}_{\text{arom}}$ ). Mass spectrum,  $m/z$  ( $I_{\text{rel}}$ , %):  $[M]^+$  487 (100), 280 (42), 207 (30). Found, %: C 78.86; H 5.16; N 2.90.  $\text{C}_{32}\text{H}_{25}\text{NO}_4$ . Calculated, %: C 78.85; H 5.13; N 2.87.

**4-(12-Oxo-12H-benzo[f]indeno[1,2-b]-quinolin-13-yl)-2-ethoxyphenyl isobutyrate (IXe).** Yield 46%, yellow crystals, mp 286°C. IR spectrum,  $\text{cm}^{-1}$ : 3055, 2971, 2936, 2834, 1765, 1602, 1567, 1468, 1404, 1331, 1285, 1246, 1200, 1171, 1145, 1117, 1072, 1034, 933, 842, 745, 702.  $^1\text{H}$  NMR spectrum,  $\delta$ , ppm: 1.30 t (3H,  $\text{MeCH}_2\text{O}$ ), 4.00 q (2H,  $\text{MeCH}_2\text{O}$ ), 1.40 d (6H,  $\text{OCOCHMe}_2$ ,  $J$  8.0 Hz), 2.85 m (1H,  $\text{OCOCHMe}_2$ ), 6.90 d (1H,  $\text{H}_{\text{arom}}$ ,  $J$  7.6 Hz), 7.05 s (1H,  $\text{H}_{\text{arom}}$ ), 7.15 m (2H,  $\text{H}_{\text{arom}}$ ), 7.50, 7.65, 7.69 m (5H,  $\text{H}_{\text{arom}}$ ), 7.93 d (1H,  $\text{H}_{\text{arom}}$ ,  $J$  7.7 Hz), 8.00–8.15 m (3H,  $\text{H}_{\text{arom}}$ ). Mass spectrum,  $m/z$  ( $I_{\text{rel}}$ , %):  $[M]^+$  487 (100), 280 (42), 207 (22). Found, %: C 78.88; H 5.12; N 2.84.  $\text{C}_{32}\text{H}_{25}\text{NO}_4$ . Calculated, %: C 78.85; H 5.13; N 2.87.

**4-(12-Oxo-12H-benzo[f]indeno[1,2-b]-quinolin-13-yl)-2-ethoxyphenyl isovalerate (IXf).** Yield 40%, yellow crystals, mp 260°C. IR spectrum,  $\text{cm}^{-1}$ : 3053, 2968, 2931, 2833, 1763, 1600, 1562, 1466, 1401, 1331, 1285, 1244, 1202, 1176, 1147, 1112, 1073, 1032, 935, 840, 748, 707.  $^1\text{H}$  NMR spectrum,  $\delta$ , ppm: 1.29 t (3H,  $\text{MeCH}_2\text{O}$ ), 3.90 q (2H,  $\text{MeCH}_2\text{O}$ ), 1.30 d [6H,

OCOCH<sub>2</sub>(CH)Me<sub>2</sub>, *J* 7.0 Hz], 1.60 m [2H, OCOCH<sub>2</sub>(CH)Me<sub>2</sub>], 2.70 m [1H, OCOCH<sub>2</sub>(CH)Me<sub>2</sub>], 6.90 d (1H, H<sub>arom</sub>, *J* 7.6 Hz), 7.10 s (1H, H<sub>arom</sub>), 7.21 m (2H, H<sub>arom</sub>), 7.55, 7.68, 7.74 m (5H, H<sub>arom</sub>), 7.89 d (1H, H<sub>arom</sub>, *J* 7.7 Hz), 8.05–8.20 m (3H, H<sub>arom</sub>). Mass spectrum, *m/z* (*I*<sub>rel.</sub>, %): [*M*]<sup>+</sup> 501 (100), 280 (50), 221 (27). Found, %: C 79.00; H 5.40; N 2.80. C<sub>33</sub>H<sub>27</sub>NO<sub>4</sub>. Calculated, %: C 79.04; H 5.38; N 2.79.

**4-(12-Oxo-12*H*-benzo[*f*]indeno[1,2-*b*]quinolin-13-yl)-2-ethoxyphenyl benzoate (IXg).** Yield 35%, yellow crystals, mp 260°C. IR spectrum, cm<sup>-1</sup>: 3055, 2968, 2837, 1766, 1602, 1506, 1407, 1334, 1281, 1246, 1177, 1145, 1112, 1073, 1038, 934, 841, 748, 703. <sup>1</sup>H NMR spectrum, δ, ppm: 1.29 t (3H, MeCH<sub>2</sub>O), 3.90 q (2H, MeCH<sub>2</sub>O), 6.87 d (1H, H<sub>arom</sub>, *J* 7.6 Hz), 7.15 s (1H, H<sub>arom</sub>), 7.26 m (2H, H<sub>arom</sub>), 7.50, 7.66, 7.78 m (8H, H<sub>arom</sub>), 7.88 d (1H, H<sub>arom</sub>, *J* 7.7 Hz), 8.10–8.25 m (5H, H<sub>arom</sub>). Mass spectrum, *m/z* (*I*<sub>rel.</sub>, %): [*M*]<sup>+</sup> 521 (100), 280 (48), 241 (30). Found, %: C 80.63; H 4.40; N 2.71. C<sub>35</sub>H<sub>23</sub>NO<sub>4</sub>. Calculated, %: C 80.61; H 4.41; N 2.69.

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## REFERENCES

1. Kozlov, N.G., Basalaeva, L.I., and Dikumar, E.A., *Khim. Polimer. Soedin.*, 2004, vol. 40, p. 79.
2. Shulov, L.M. and Kheifits, L.A., *Dushistye veshchestva i poluprodukty parfyumerno-kocmeticheskogo proizvodstva: Spravochnik* (Fragrant Chemicals and Intermediates of Perfumery Cosmetics Industry: Handbook), Moscow: Agropromizdat, 1990, 208 p.
3. Shaikh, Y., *Specialty Aroma Chemicals in Flavors and Fragrance*, Illinois: Allured Publishing, 2002, 165 p.
4. Voitkevich, S.A. and Kheifits, L.A., *Ot drevnikh blagovonii k sovremennym parfyumerii i kocmetike* (From Ancient Incenses to Modern Perfumery and Cosmetics), Moscow: Pishch. Prom., 1997, 218 p.
5. Kozlov, N.G. and Gusak, K.N., *Zh. Org. Khim.* 1999, vol. 35, p. 426.
6. Martinez, R., Cortes, E., and Toscano, R.A., *J. Heterocycl. Chem.* 1990, vol. 27, p. 363.
7. Daier, D.R., *Prilozhenie absorbtionnoi spektroskopii organicheskikh soedinenii* (Application of Absorption Spectroscopy of Organic Compounds), Moscow: Khimiya, 1970, p. 100.