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SYNTHESIS AND STUDY OF ANTIOXIDANT ACTIVITY OF SOME 2-SUBSTITUTED 1,3-DIAZAADAMANTANES CONTAINING INDOLE FRAGMENT

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Condensation of 9-hydroxy-, 9-oxo-, 1,5-dialkyl-3,7-diazabicyclo[3.3.1]nonanes with various indole-3-aldehydes synthesized a new series of 1,3-diazaadamantanes and studied their antioxidant activity. According to the results of biological tests, some derivatives of this series have moderate antioxidant activity, especially compounds, containing a hydroxyl group in 6-th position of the diazaadamantane ring.

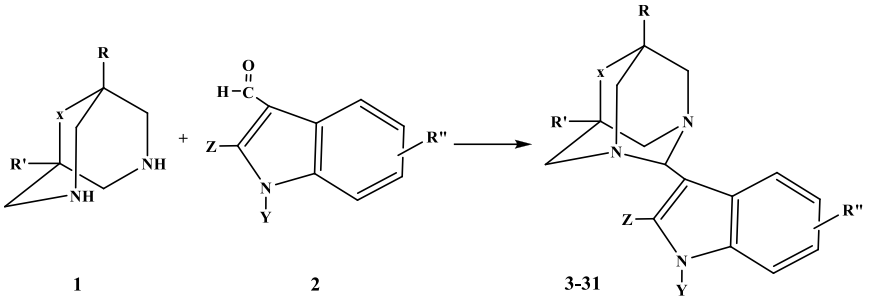
References 8.

Indole derivatives have been studied for a long time as prodrugs that provide transport across the cell membrane. Known antiemetic, antiarrhythmic, antiviral, ophthalmic drugs: Propindol, Pinalol, Arbidol, Metisazon [1]. On the other hand, there are known effective antiviral drugs, derivatives of adamantine: Amantandine, Remantadine [2]. The presence of nitrogen atoms in the adamantane ring can lead to unique properties in the derivatives of this class.

The aim of this work is to synthesize a new series of compounds, where fragments of these two biologically active substances are combined.

The starting compounds were 9-hydroxy-, 9-oxo- and 1,5-dialkyl-3,7-diazabicyclo[3.3.1]nonanes **1**, the synthesis of which is given in works [3,4] and substituted indole-3-aldehydes **2**, synthesized according to the methods described in work [5].

Scheme



1 2 3-31

R = R' = CH_3, X = C = O, Y = Z = R" = H **(3)**; R = R' = CH_3, Z = Y= H, R" = 6'-Cl **(4)**; R = R' = CH_3, X = C = O, Y = CH_2CH_2CN, R" = H **(5)**; R = R' = CH_3, X = C = O, R" = H, Y = CH_2CH_2COOH, **(6)**; R = CH_3, R' = C_2H_5, X = C = O, Y = H, Z = 2'-CH_3, R" = H **(7)**; R = CH_3, R' = C_2H_5, X = C = O, R" = 5-OCH_3, Y = Z = H **(8)**; R = CH_3, R' = C_2H_5, X = C = O, Y = $CH_2C_6H_5$, Z = 2'-CH_3, R" = H **(9)**; R = CH_3, R' = C_2H_5, X = C = O, Y = CH_2CH_2COOH, Z = R" = H **(10)**; R = R' = C_2H_5, X = C = O, Z = Y = R" = H **(11)**; R = R' = C_2H_5, X = C = O, Z = Y= H, R" = 5'-OCH_3, **(12)**; R = R' = C_2H_5, X = C = O, Y = C_2H_5, Z = CH_3, R" = H **(13)**; R = R' = C_2H_5, X = C = O, Z = R" = H, Y = CH_2CH_2COOH **(14)**; R = R' = C_2H_5, X = C = O, Y = $CH_2C_6H_5$, Z = 2'-CH_3, **(15)**; R = CH_3, R' = C_3H_7, X = C = O, Y = $CH_2C_6H_5$, Z = R" =H **(16)**; R = CH_3, R' = C_4H_7, X = C = O, Z = Y = R" =H, **(17)**; R = CH_3, R' = C_4H_9, X = C = O, Z = Y = CH_3, R" = H, **(18)**; R = CH_3, R' = C_6H_5, X = C = O, Y = $CH_2C_6H_5$, Z = 2'-CH_3 **(19)**; R = R' = C_3H_7, X = C = O, Y = Z = R" = H, **(20)**; R = R' = C_3H_7, X = C = O, Y = 1'-CH_3 **(21)**; R = R' = C_3H_7, X = C = O, Y = 1'-C_2H_5 **(22)**; R = R' = C_3H_7, X = C = O, Y = 1'-C_2H_5, Z = 2'-CH_3, R" = H **(23)**; R = R' = C_3H_7, X = C = O, Y = Z = CH_3 **(24)**; R = R' = C_3H_7, X = C = O, Y = $CH_2C_6H_5$, Z = R" = H **(25)**; R = R' = C_2H_5, X = CHOH, Y = $CH_2C_6H_5$, Z = CH_3, R" = H **(26)**; R = R' = CH_3, X = CHOH, Z = Y= H, R" = 6'-Cl **(27)**; R = R' = C_2H_5, X = CHOH, Y= R" =H, Z = 2'-CH_3 **(28)**; R = R' = CH_3, X = CHOH, Y= Z =H, R" = 5'-OCH_3 **(29)**; R = R' = CH_3, X = CH_2, Y = R" = H, Z = 2'-CH_3 **(30)**; R = R' = CH_3, X = C = CH_2, Y= Z = CH_3 **(31)**.

The structure of the synthesized compounds was confirmed by the data of elemental analysis, IR, ^1H and ^{13}C NMR spectra.

The antioxidant activity of the synthesized compounds was investigated, which was studied in homogenates of rat brain tissue in *in vitro* experiments according to the method [6,7]. Determination of the level of lipid peroxides was carried out in a non-enzymatic system by peroxidation according to the yield of one of the final product malonic dialdehyde (MDA), which forms a complex compound with thiobarbituric acid in the form of a pink chromogen. The optical density of the colored product was recorded taking into account the absorption density at a wavelength of 534 *nm*, which corresponded to the amount of the formed peroxide. Compounds were studied at a concentration of 10^{-3}-10^{-4} *M* and added to the incubation medium immediately before incubation. A test with induced lipid peroxidation (LPO) was used as a control, where a solvent was added instead of compounds. The antioxidant activity was judged by the percentage changes in the amount of MDA in the experimental samples compared to the control ones.

According to the results of biological studies, only compounds 2-(1'-benzyl-2'-methyl-3'-indolyl)-5,7-diethyl-6-hydroxy-1,3-diazaadamantane **(26)** and 2-(2'-methyl-3'-indolyl)-5,7-diethyl-6-hydroxy-1,3-diazaadamantane **(28)** exhibit an antioxidant effect at a concentration of 10^{-3} M, reliably inhibit the process of lipid oxidation in the form of a decrease in the amount of MDA within 26 and 17%, respectively, compared with the control. The rest of the compounds of this series do not show an inhibitory effect. It was found that at a concentration of 10^{-4} *M* compounds **6**, **14**, **15** slightly increase the level of MDA, which indicates the ability of these compounds to increase the intensity of peroxide reactions, i.e. have a prooxidant effect.

Thus, a weak antioxidant effect was found in two compounds containing a hydroxyl group in the structure, which is located in 6-th position of the diazaadamantane ring.

Experimental part

IR spectra were recorded on a "Nikolet Avatar 330 FT-IR" spectrometer from samples dispersed in mineral oil. The ^{1}H and ^{13}C NMR spectra were recorded on a Varian "Mercury-300VX" instrument at 303 *K* with a frequency of 300.078 and 75.46 *MHz*, respectively. In the assignment of signals, the methods of double resonance, DEPT and HMQC were used. Chemical shifts are given in ppm relative to the internal TMS for DMSO-d_6/CCl_4 1/3 solutions. The progress of reactions and the purity of products were monitored by TLC on Silufol UV-254 plates using propaol-water (7:3) as eluent, development with iodine vapor.

General procedure for the preparation of 6-hydroxy-, 6-oxo-, 5,7-dialkyl-2-indolyl-1,3-diazaadamantanes (3-31). To an alcoholic solution of 10 *mmol* of the corresponding 1,5-dialkyl-3,7-diazabicyclo[3,3,1]nonane **1** add 10 *mmol* of the corresponding indole-3-aldehyde **2** and the reaction mixture is boiled for 5-8 *h*. During this time, a precipitate forms. After completion of the reaction the precipitate is filtered, washed with ethanol and recrystallized. If there is no precipitate, ethanol is evaporated, the residue is recrystallized from a mixture of ETHANOL:DMF (2:1).

2-(3'-Indolyl)-5,7-dimethyl-6-oxo-1,3-diazaadamantane (3) published in [8].

2-(6'-Chloro-3'-indolyl)-5,7-dimethyl-6-oxo-1,3-diazaadamantane (4) was synthesized from 1,5-dimethyl-9-oxo-3,7-diazabicyclo[3.3.1]nonane and 6-chloroindolyl-3-aldehyde. Yield 1.9 *g* (58%), R_f 0.25, mp. > 250°C. IR spectrum, ν, cm^{-1}: 1618 ($C=C_{arom}$), 1651 (C=O), 3455 (NH). ^{1}H NMR spectrum, δ, ppm, *Hz*: 0.62 s (3H, CH_3); 0.84 s (3H, CH_3); 2.74 br. d (2H, *J* = 12.5, NCH_2); 3.18 br. d (2H, *J* = 12.5, NCH_2); 3.51 br. d (4H, *J* = 12.8, $2\times NCH_2$); 5.30 s (1H, NCHN); 6.86 d (1H, *J* = 8.0, H_{arom}); 7.18 s (1H,

H_{arom}); 7.36 s (1H, H_{arom}); 7.82 d (1H, *J* = 8.0, H_{arom}); 10.98 br. s (1H, NH). ^{13}C NMR spectrum δ, ppm: 15.7, 15.9, 44.8, 45.0, 59.2, 66.4, 76.0, 110.7, 111.9, 118.7, 121.6, 124.3, 124.4, 126.0, 136.8, 210.1. Found, %: C 65.08; H 6.50; N 12.60; Cl 10.76. $C_{18}H_{20}N_3ClO$. Calculated, %: C 65.15; H 6.55; N 12.66; Cl 10.70.

2-(1'-Cyanoethyl-3'-indolyl)-5,7-dimethyl-6-oxo-1,3-diazaadamantane (5) was synthesized from 1,5-dimethyl-9-oxo-3,7-diazabicyclo[3.3.1]nonane and 1-cyanoethylindolyl-3-aldehyde. Yield 2.1 *g* (60%), R_f 0.75, mp. 215-217°C. IR spectrum, ν, cm^{-1}: 1620 (C=C_{arom}), 1697 (C=O), 2230 (C≡N). ^1H NMR spectrum, δ, ppm, *Hz*: 0.65 s (3H, CH_3); 0.88 s (3H, CH_3); 2.78 br. d (2H, *J* = 12.5, NCH_2); 2.96 dd (2H, *J* = 8.1, 1.2, NCH_2); 3.18 br. d (2H, *J* = 12.8, NCH_2); 3.48-3.61 m (4H, 2×NCH_2); 4.51 dd (2H, *J* = 8.0, 7.1, NCH_2); 5.32 s (1H, NCHN); 6.88 ddd (1H, J = 8.0, 7.0, 1.1, H_{arom}); 7.10 t (1H, *J* = 8.0, H_{arom}); 7.31 s (1H, H_{arom}), 7.41 d (1H, *J* = 5.8, H_{arom}); 7.82 d (1H, *J* = 8.0, H_{arom}). Found, %: C 72.60; H 7.0; N 16.24. $C_{21}H_{24}N_4O$. Calculated, %: C 72.66; H 6.93; N 16.18.

2-(1'-Carboxyethyl-3'-indolyl)-5,7-dimethyl-6-oxo-1,3-diazaadamantane (6) was synthesized from 1,5-dimethyl-6-oxo-3,7-diazabicyclo[3.3.1]nonane and 1-carboxyethylindolyl-3-aldehyde. Yield 2.5 *g* (65%), R_f 0.72, mp. 230-231°C. IR spectrum, ν, cm^{-1}: 1608 (C=C_{arom}), 1713 (C=O), 3144 (COOH). ^1H NMR spectrum, δ, ppm, *Hz*: 0.62 s (3H, CH_3); 0.88 s (3H, CH_3); 2.76 br. d (4H, *J* = 12.5, 2×NCH_2); 3.18 br. d (2H, *J* = 12.5, NCH_2); 3.42-3.60 m (4H, 2×CH_2); 4.40 dd (2H, *J* = 8.0, 7.1, NCH_2); 5.31 s (1H, NCHN); 6.88 ddd (1H, *J* = 8.0, 7.0, 1.1, H_{arom}); 7.05 ddd (1H, *J* = 8.0, 7.1, 1.2, H_{arom}); 7.21 s (1H, H_{arom}), 7.38 br. d (1H, *J* = 5.8, H_{arom}); 7.85 d (1H, *J* = 8.0, H_{arom}); 11.25 br. s (COOH). Found, %: C 68.73; H 6.88; N 11.25. $C_{22}H_{25}N_3O_3$. Calculated, %: C 68.66; H 6.81; N 11.20.

2-(2'-Methyl-3'-indolyl)-5-methyl-7-ethyl-6-oxo-1,3-diazaadamantane (7) was synthesized from 1-methyl-5-ethyl-9-oxo-3,7-diazabicyclo[3.3.1]nonane and 2-methylindolyl-3-aldehyde. Yield 2.1 *g* (65%), R_f 0.68, mp. 212-213°C. IR spectrum, ν, cm^{-1}: 1610 (C=C_{arom}), 1715 (C=O), 3450 (NH). ^1H NMR spectrum, δ, ppm, *Hz*: 0.65 t (3H, *J* = 6.8, CH_3); 0.97 t (3H, *J* = 6.1, CH_3); 1.18-1.42 m (2H, $\underline{CH_2}CH_3$); 2.58 s (3H, CH_3-$_{indole}$); 2.72-2.81 m (2H, NCH_2); 3.15-3.25 m (2H, NCH_2); 3.39-3.60 m (4H, 2×NCH_2); 5.31 s (1H, NCHN); 6.76 ddd (1H, *J* = 8.0, 7.0, 1.2, H_{arom}); 6.88 ddd (1H, *J* = 8.0, 7.0, 1.1, H_{arom}); 7.20 d (1H, *J* = 5.8, H_{arom}); 7.84 d (1H, *J* = 8.0, H_{arom}); 10.25 br. s (1H, NH). Found, %: C 74.50; H 7.78; N 13.07. $C_{20}H_{25}N_3O$. Calculated, %: C 74.43; H 7.73; N 13.00.

2-(5'-Methoxy-3'-indolyl)-5,7-dimethyl-6-oxo-1,3-diazaadamantane (8) was synthesized from 1-methyl-5-ethyl-9-oxo-3,7-diazabicyclo[3.3.1]nonane and 2-methoxyindolyl-3-aldehyde. Yield 2.1 *g* (62%), R_f 0.71, mp. 256-257 °C. IR spectrum, ν, cm^{-1}: 1622 (C=C_{arom}), 1676 (C=O), 3308 (NH). ^1H NMR spectrum, δ, ppm, *Hz*: 0.62 s (1.5H) and 0.72 t

(1.5H, *J* = 7.5, CH_3); 0.94 t (3H, *J* = 7.5, CH_3); 1.21 q (1H, *J* = 7.5) and 1.41 q (1H, *J* = 7.5, $\underline{CH_2}CH_3$); 2.78 d (2H, *J* = 5.9, NCH_2); 3.20 dd (2H, *J* = 8.1, 7.1, NCH_2); 3.58 br. d (4H, *J* = 12.9, 2×NCH_2); 3.76 br. s (3H, OCH_3); 5.28 br. s (1H, NCHN); 6.55 d (1H, *J* = 5.9, H_{arom}); 7.16 s (1H, H_{arom}); 7.22 d (1H, *J* = 5.9, H_{arom}); 7.33 s (1H, H_{arom}); 10.60 br. s (1H, NH). Found, %: C 70.85; H 7.43; N 12.31. $C_{20}H_{25}N_3O_2$. Calculated, %: C 70.79; H 7.37; N 12.38.

2-(1'-Benzyl-2'-methyl-3'-indolyl)-5-methyl-7-ethyl-6-oxo-1,3-diazaadamantane (9) was synthesized from 1-methyl-5-ethyl-9-oxo-3,7-diazabicyclo[3.3.1]nonane and 1-benzyl-2-methylindolyl-3-aldehyde. Yield 2.4 *g* (58%), R_f 0.78, mp. 195-196ºC. IR spectrum, ν, cm^{-1}: 1608 (C=C_{arom}), 1710 (C=O). ^{1}H NMR spectrum, δ, ppm, *Hz*: 0.71 t (3H, *J* = 7.5, CH_3); 0.94 t (3H, *J* = 7.5, CH_3); 1.18 q (1H, *J* = 7.5) and 1.43 q (1H, *J* = 7.5, $\underline{CH_2}CH_3$); 2.80 t (2H, *J* = 7.5, NCH_2); 2.88 s (3H, CH_3); 3.22 t (2H, *J* = 7.5, NCH_2); 3.41 br. d (2H, *J* = 12.8, NCH_2); 3.55-3.61 m (2H, NCH_2); 5.38 s (2H, $\underline{CH_2}C_6H_5$); 5.42 d (1H, *J* = 5.8, NCHN); 6.82-7.1 m (4H, H_{arom}); 7.19-7.22 m (4H, H_{arom}); 8.05 d (1H, *J* = 7.1, H_{arom}). ^{13}C NMR spectrum δ, ppm: 6.85 and 7.15, 10.66, 15.71 and 16.06, 23.2 and 23.4, 44.8 and 45.2, 45.3 and 45.4, 46.9, 47.4 and 47.5, 57.5, 59.6, 64.1, 66.2, 77.5, 95.4 and 95.5, 95.6, 107.3 and 108.2, 118.6 and 118.7, 120.3 and 121.2, 125.2 and 125.3, 126.4 and 126.5, 128.0 and 128.1, 133.9, 136.2, 137.6, 137.7, 210.3. Found, %: C 78.53; H 7.56; N 10.11. $C_{27}H_{31}N_3O$. Calculated, %: C 78.45; H 7.50; N 10.08.

2-(1'-Carboxyethyl-3'-indolyl)-5-methyl-7-ethyl-6-oxo-1,3-diazaadamantane (10) was synthesized from 1-methyl-5-ethyl-9-oxo-3,7-diazabicyclo[3.3.1]nonane and 1-carboxyethylindolyl-3-aldehyde. Yield 2.5 *g* (65%), R_f 0.72, mp. 230-231ºC. IR spectrum, ν, cm^{-1}: 1610 (C=C_{arom}), 1708 (C=O), 3441 (COOH). ^{1}H NMR spectrum, δ, ppm, *Hz*: 0.72 t (3H, *J* = 7.5, CH_3); 0.88 t (3H, *J* = 7.5, CH_3); 1.16 q (1H, *J* = 7.6) and 1.42 q (1H, *J* = 7.1, NCH_2); 2.61-2.82 m (4H, 2×NCH_2); 3.16 br. d (2H, *J* = 12.9, NCH_2); 3.42-3.60 m (4H, 2×CH_2); 4.40 dd (2H, *J* = 8.0, 7.1, NCH_2); 5.31 s (1H, NCHN); 6.86 ddd (1H, *J* = 8.0, 7.0, 1.1, H_{arom}); 7.1 dd (1H, *J* = 8.1, 7.1, H_{arom}); 7.2 s (1H, H_{arom}), 7.36 d (1H, *J* = 8.1, H_{arom}); 7.84 d (1H, *J* = 8.0, H_{arom}); 11.4 br. s (COOH). Found, %: C 69.34; H 7.14; N 11.08. $C_{22}H_{27}N_3O_3$. Calculated, %: C 69.29; H 7.08; N 11.02.

2-(3'-Indolyl)-5,7-diethyl-6-oxo-1,3-diazaadamantane (11) was synthesized from 5,7-diethyl-9-oxo-3,7-diazabicyclo[3.3.1]nonane and indolyl-3-aldehyde. Yield 2.0 *g* (62%), R_f 0.67, mp. 221-222°C. IR spectrum, ν, cm^{-1}: 1608 (C=C_{arom}), 1710 (C=O), 3440 (NH). ^{1}H NMR spectrum, δ, ppm, *Hz*: 0.72 t (3H, *J* = 7.5, CH_3); 0.94 t (3H, *J* = 7.5, CH_3); 1.16 q (2H, *J* = 7.5, $\underline{CH_2}CH_3$); 1.43 q (2H, *J* = 7.5, $\underline{CH_2}CH_3$); 2.77 br. d (2H, *J* = 12.9, NCH_2); 3.19 br. d (2H, *J* = 12.9, NCH_2); 3.49-3.58 m (4H, 2×NCH_2); 5.33 s (1H, NCHN); 6.88 ddd (1H, *J* = 8.0, 7.0, 1.0, H_{arom}); 7.01 ddd (1H, *J* = 8.1, 7.0, 1.2, H_{arom}); 7.17 dd (1H, *J* = 2.4, 1.4, = CHN); 7.32 dt (1H, *J* = 8.1, 1.0,

H_{arom}), 7.85 br. d (1H, *J* = 8.0, H_{arom}); 10.78 br. s (1H, NH). ^{13}C NMR spectrum δ, ppm: 6.9, 7.1, 23.1, 23.4, 38.9, 39.5, 40.1, 47.2, 47.5, 57.3, 64.5, 76.8, 110.8, 111.6, 118.0, 120.0, 120.6, 123.3, 125.5, 136.4, 210.1. Found, %: C 74.35; H 8.15; N 13.06. $C_{20}H_{25}N_3O$. Calculated, %: C 74.30; H 8.07; N 13.0.

2-(3'-Indolyl-5'-methoxy)-5,7-diethyl-6-oxo-1,3-diazaadamantane (12) was synthesized from 5,7-diethyl-9-oxo-3,7-diazabicyclo[3.3.1]nonane and 5-methoxyindolyl-3-aldehyde. Yield 2.2 *g* (61%), R_f 0.71, mp. 201-202°C. IR spectrum, ν, cm^{-1}: 1611 (C=C_{arom}), 1708 (C=O), 3310 (NH). ^1H NMR spectrum, δ, ppm, *Hz*: 0.72 t (3H, *J* = 7.5, CH_3); 0.94 t (3H, *J* = 7.5, CH_3); 1.18 q (2H, *J* = 7.5, $\underline{CH_2}CH_3$); 1.42 q (2H, *J* = 7.5, $\underline{CH_2}CH_3$); 2.78 br. d (2H, *J* = 12.9, NCH_2); 3.19 br. d (2H, *J* = 12.5, NCH_2); 3.48-3.58 m (4H, 2×NCH_2); 3.98 br. s (3H, OCH_3); 5.33 s (1H, NCHN); 6.56 d (1H, *J* = 5.9, H_{arom}); 6.82 ddd (1H, *J* = 8.0, 7.0, 1.2, H_{arom}); 7.10 br. s (1H, = CHN); 7.45 br. d (1H, *J* = 12.5, H_{arom}); 10.80 br. s (1H, NH). ^{13}C NMR spectrum δ, ppm: 6.9, 7.2, 23.1, 23.4, 40.0, 40.3, 47.2, 47.5, 57.3, 64.3, 76.8, 100.8, 112.2, 113.7, 118.4, 123.2, 126.5, 127.1, 145.5, 210.1. Found, %: C 71.43; H 7.72; N 11.82. $C_{21}H_{27}N_3O_2$. Calculated, %: C 71.38; H 7.68; N 11.89.

2-(1'-Ethyl-2'-methyl-3'-indolyl)-5,7-diethyl-6-oxo-1,3-diazaadamantane (13) was synthesized from 5,7-diethyl-9-oxo-3,7-diazabicyclo[3.3.1]nonane and 1-ethyl-2-methylindolyl-3-aldehyde. Yield 2.5 *g* (61%), R_f 0.76, mp. 158-159°C. IR spectrum, ν, cm^{-1}: 1605 (C=C_{arom}), 1693 (C=O). ^1H NMR spectrum, δ, ppm, *Hz*: 0.76 dd (3H, *J* = 7.1, 1.4, CH_3); 0.94 dd (3H, *J* = 7.1, 1.4, CH_3); 1.18 q (2H, *J* = 7.5, $\underline{CH_2}CH_3$); 1.31-1.45 m (5H, CH_2CH_3); 2.58 s (3H, CH_3); 2.82 br. d (2H, *J* = 12.5, NCH_2); 3.18 br. d (2H, *J* = 13.5, NCH_2); 3.36 br. d (2H, *J* = 13.5, NCH_2); 3.58 br. d (2H, *J* = 13.5, NCH_2); 4.18 dd (2H, *J* = 8.1, 5.9, NCH_2); 5.31 s (1H, NCHN); 6.86 ddd (1H, *J* = 8.1, 7.0, 1.1, H_{arom}); 7.02 ddd (1H, *J* = 8.1, 7.0, 1.1, H_{arom}); 7.18 d (1H, *J* = 7.1, H_{arom}); 7.91 d (1H, *J* = 5.9, H_{arom}). ^{13}C NMR spectrum δ, ppm: 6.93, 7.2, 10.3, 14.6, 23.1, 23.5, 36.6, 38.9, 47.1, 47.5, 57.6, 64.1, 77.9, 106, 107.7, 118.3, 119.8, 121.2, 126.4, 133.0, 135.2, 210.2. Found, %: C 77.02; H 9.32; N 9.92. $C_{27}H_{31}N_3O_2$. Calculated, %: C 76.95; H 9.26; N 9.91.

2-(1'-Carboxyethyl-3'-indolyl)-5,7-diethyl-6-oxo-1,3-diazaadamantane (14) was synthesized from 5,7-diethyl-9-oxo-3,7-diazabicyclo[3.3.1]nonane and 1-carboxyethylindolyl-3-aldehyde. Yield 2.4 *g* (61%), R_f 0.78, mp. 220-221°C. IR spectrum, ν, cm^{-1}: 1608 (C=C_{arom}), 1712 (C=O), 3440 (COOH). ^1H NMR spectrum, δ, ppm, *Hz*: 0.71 t (3H, *J* = 6.8, $CH_2\underline{CH_3}$); 0.95 t (3H, *J* = 7.0, $CH_2\underline{CH_3}$); 1.19 q (2H, *J* = 7.5, $\underline{CH_2}CH_3$); 1.41 q (2H, *J* = 7.5, $\underline{CH_2}CH_3$); 2.76 br. d (4H, *J* = 12.5, 2×NCH_2); 3.18 br. d (2H, *J* = 12.5, NCH_2); 3.42-3.60 m (4H, 2×CH_2); 4.40 dd (2H, *J* = 8.0, 7.0, NCH_2); 5.32 s (1H, NCHN); 6.88 ddd (1H, *J* = 8.0, 7.0, 1.1, H_{arom}); 7.05 ddd (1H, *J* = 8.1, 7.1, 1.1, H_{arom}); 7.21 s (1H, H_{arom}); 7.38 d (1H, *J* = 8.0, H_{arom});

7.86 d (1H, *J* = 8.0, H_{arom}); 11.30 very br. s (COOH). Found, %: C 69.91; H 7.39; N 10.65. $C_{23}H_{29}N_3O_3$. Calculated, %: C 69.87; H 7.34; N 10.60.

2-(1'-Ethyl-2'-methyl-3'-indolyl)-5-methyl-7-propyl-6-oxo-1,3-diazaadamantan (15) was synthesized from 5-methyl-7-propyl-9-oxo-3,7-diazabicyclo[3.3.1]nonane and 1-ethyl-2-methylindolyl-3-aldehyde. Yield 2.2 *g* (60%), R_f 0.68, mp. 165 °C. IR spectrum, ν, cm^{-1}: 1608 (C=C_{arom}), 1698 (C=O). ^{1}H NMR spectrum, δ, ppm, *Hz*: 0.62 s (0.8H) and 0.78 dd (2.2H, *J* = 8.0, 7.1, CH_3); 0.91 s (2.1H) and 0.94 dd (0.9H, *J* = 12.5, 3.4, CH_3); 1.08-1.21 m (3H, CH_3); 1.31-1.40 dd (4H, *J* = 13.9, 1.2, $\underline{CH_2}\underline{CH_2}CH_3$); 2.58 s (3H, CH_3); 2.80 d (2H, *J* = 12.5, NCH_2); 3.21 t (2H, *J* = 7.5, NCH_2); 3.4 br. d (2H, *J* = 12.5, NCH_2); 3.54 br. d (2H, *J* = 12.5, NCH_2); 4.16 dd (2H, *J* = 8.1, 7.0, $\underline{CH_2}CH_3$); 5.34 br. s (1H, NCHN); 6.86 ddd (1H, *J* = 8.0, 7.1, 1.0, H_{arom}); 7.02 ddd (1H, *J* = 8.1, 7.0, 1.2, H_{arom}); 7.20 d (1H, *J* = 8.1, H_{arom}); 7.94 d (1H, *J* = 8.0, H_{arom}). ^{13}C NMR spectrum δ, ppm: 10.9, 14.4, 14.6, 15.3, 15.6, 15.7, 16.0, 33.0, 40.1, 44.8, 47.5, 57.9, 59.5, 64.4, 77.7, 106.6, 118.3, 119.9, 121.1, 126.4, 132.9, 135.1, 210.2. Found, %: C 75.68; H 9.01; N 11.55. $C_{23}H_{31}N_3O_2$. Calculated, %: C 75.61; H 8.94; N 11.50.

2-(1'-Benzyl-3'-indolyl)-5-methyl-7-propyl-6-oxo-1,3-diazaadamantane (16) was synthesized from 5-methyl-7-propyl-9-oxo-3,7-diazabicyclo[3.3.1]nonane and 1-benzylindolyl-3-aldehyde. Yield 2.2 *g* (60%), R_f 0.68, mp. 165°C. IR spectrum, ν, cm^{-1}: 1608 (C=C_{arom}), 1710 (C=O). ^{1}H NMR spectrum, δ, ppm, *Hz*: 0.65 s (0.4H) and 0.84 s (2.6H, CH_3); 1.01 br. s (3H, CH_3); 1.08-1.10 m (4H, $\underline{CH_2}\underline{CH_2}CH_3$); 2.82 t (2H, *J* = 6.8, NCH_2); 3.30 t (2H, *J* = 6.7, NCH_2); 3.64 q (4H, 2×NCH_2); 5.36 s (2H, $\underline{CH_2}C_6H_5$); 5.50 s (1H, NCHN); 7.2-7.4 m (9H, H_{arom}); 8.0 br. d (1H, H_{arom}). Found, %: C 78.51; H 7.56; N 10.12. $C_{27}H_{31}N_3O$. Calculated, %: C 78.45; H 7.50; N 10.16.

2-(3'-Indolyl)-5-methyl-7-butyl-6-oxo-1,3-diazaadamantane (17) was synthesized from 5-methyl-7-butyl-9-oxo-3,7-diazabicyclo[3.3.1]nonane and indolyl-3-aldehyde. Yield 2.4 *g* (71%), R_f 0.74, mp. 185-187°C. IR spectrum, ν, cm^{-1}: 1612 (C=C_{arom}), 1708 (C=O), 3325 (NH). ^{1}H NMR spectrum, δ, ppm, *Hz*: 0.64 s (1.5H) and 0.30 s (1.5H, CH_3); 0.83 t (1.5H, *J* = 7.0) and 0.96 t (1.5H, *J* = 6.7, $\underline{CH_3}(CH_2)_3$); 1.06-1.23 m (3H) and 1.29-1.41 m (3H, $CH_3(\underline{CH_2})_3$); 2.72 br. d (1H, *J* = 13.0), 2.78 br. d (1H, *J* = 12.9,), 3.13-3.23 m (2H) and 3.50-3.59 m (4H, 4×NCH_2); 5.33 br. s (0.5H) and 5.34 br. s (0.5H, CH); 6.88 ddd (1H, *J* = 8.0, 7.0, 1.0); 7.16 t (0.5H, *J* = 1.3) and 7.17 t (0.5H, *J* = 1.3, = $\underline{CH}$NH); 6.98-7.04 m (1H), 7.32 d (1H, *J* = 8.0) and 7.84 br. d (1H, *J* = 8.0, H_{arom}); 10.78 br. s (1H, NH). ^{13}C NMR spectrum δ, ppm: 13.5 and 13.6 (CH_3), 15.8 and 16.0 (CH_3), 22.9 and 23.1 (CH_2), 45.0 and 45.3 (CH_2), 47.2 and 47.2 (C^*), 57.8 (CH_2) , 59.3 (CH_2), 64.8 (CH_2), 66.5 (CH_2), 76.6 and 76.7 (CH), 110.9 (CH), 111.7 and 114.7 (CH), 118.2 (CH), 120.4 (CH), 120.7 (CH), 123.4 and 123.5, 125.6, 136.5 (=CHN),

210.2 and 210.3 (C=O). Found, %: C 74.83; H 8.08; N 12.51. $C_{21}H_{27}N_3O$. Calculated, %: C 74.77; H 8.01; N 12.46.

2-(1'2'-Dimethyl-3'-indolyl)-5-methyl-7-butyl-6-oxo-1,3-diazaadamantane (18) was synthesized from 5-methyl-7-butyl-9-oxo-3,7-diazabicyclo[3.3.1]nonane and 1,2-dimethylindolyl-3-aldehyde. Yield 2.2 *g* (62%), R_f 0.75, mp. 208-209°C. IR spectrum, ν, cm^{-1}: 1606 (C=C_{arom}), 1688 (C=O). ^{1}H NMR spectrum, δ, ppm, *Hz*: 0.65 s (2.6H) and 0.89 s (0.4H, CH_3); 0.83 t (0.4H, *J* = 6.9) and 0.96 t (2.6H, *J* = 6.8, $\underline{CH_3}(CH_2)_3$); 1.07 m (1H) and 1.25-1.43 m (5H, $(\underline{CH_2})_3CH_3$); 2.59 br. s (3H, CH_3); 2.75 br. d (2H, *J* = 12.7), 3.22 br. d (2H, *J* = 12.5), 3.35-3.43 m (2H) and 3.50-3.60 m (2H, 4×CH_2); 3.69 br. s (3H, NCH_3); 5.35 br. s (0.86H) and 5.37 br. s (0.14H, CH); 6.86 ddd (1H, *J* = 8.0, 7.0, 1.0), 7.01 ddd (1H, *J* = 8.1, 7.0, 1.2), 7.20 br. d (1H, *J* = 8.1) and 7.94 br. d (0.5H, *J* = 8.0, H_{arom}). ^{13}C NMR spectrum δ, ppm: main isomer 10.7, 13.6, 16.0, 23.1, 24.6, 28.6, 30.3, 40.1, 45.2, 47.0, 59.5, 64.4, 77.5, 106.5, 107.8, 118.3, 119.9, 121.0, 126.2, 133.9, 136.3, 210.3. Found, %: C 75.68; H 8.55; N 11.43. $C_{23}H_{31}N_3O$. Calculated, %: C 75.61; H 8.49; N 11.50.

2-(1'-Benzyl-2'-methyl-3'-indolyl)-5-methyl-7-phenyl-6-oxo-1,3-diazaadamantane (19) was synthesized from 5-methyl-7-phenyl-9-oxo-3,7-diazabicyclo[3.3.1]nonane and 1-benzyl-2-methylindolyl-3-aldehyde. Yield 2.6 *g* (56%), R_f 0.78, mp. 251-252°C. IR spectrum, ν, cm^{-1}: 1620 (C=C_{arom}), 1720 (C=O). ^{1}H NMR spectrum, δ, ppm, *Hz*: 0.74 s (3H, CH_3); 2.57 s (3H, CH_3); 3.00 br. d (2H, *J* = 12.8), 3.53 br. d (2H, *J* = 12.8) and 3.83-3.98 m (4H, 4×CH_2); 5.39 s (2H, $\underline{CH_2}C_6H_5$); 5.52 s (1H, NCHN); 6.90-7.04 m (4H), 7.16-7.29 m (7H), 7.33-7.40 m (2H) and 8.07 br. d (1H, *J* = 7.9, H_{arom}). ^{13}C NMR spectrum δ, ppm: 10.7 (CH_3), 16.4 (CH_3), 45.2, 45.4 (CH_2), 50.9, 59.4 (CH_2), 64.6 (CH_2), 77.2, 107.1, 108.3 (CH), 118.7 (CH), 120.3 (CH), 121 (CH), 125.3 (2×CH), 126.1, 126.4 (2×CH), 126.5, 127.4 (2×CH), 128.1 (2×CH), 134.0, 136.3, 137.6 , 138.2, 208.1 (C=O). Found, %: C 80.74; H 6.77; N 9.18. $C_{31}H_{31}N_3O$. Calculated, %: C 80.69; H 6.72; N 9.11.

2-(3'-Indolyl)-5,7-dipropyl-6-oxo-1,3-diazaadamantane (20) was synthesized from 5,7-dipropyl-9-oxo-3,7-diazabicyclo[3.3.1]nonane and indolyl-3-aldehyde. Yield 2.2 *g* (63%), R_f 0.76, mp. 161-162°C. IR spectrum, ν, cm^{-1}: 1618 (C=C_{arom}), 1708 (C=O); 3440 (NH). ^{1}H NMR spectrum, δ, ppm, *Hz*: 0.79 t (3H, *J* = 6.8, CH_3); 0.97 t (3H, *J* = 6.1, $CH_2CH_2\underline{CH_3}$); 1.02-1.19 m (4H) and 1.28-1.41 m (4H, 2×$(\underline{CH_2})_2CH_3$); 2.75 br. d (2H, *J* = 12.5), 3.19 br. d (2H, *J* = 12.5), 3.54 br. d (4H, *J* = 12.5, 4×NCH_2); 5.32 br. s (1H, NCHN); 6.88 ddd (1H, *J* = 8.0, 7.0, 1.0), 7.01 ddd (1H, *J* = 8.0, 7.0, 1.2), 7.32 br. d (1H, *J* = 8.0) and 7.84 br. d (1H, *J* = 8.0, H_{arom}); 7.16 d (0.5H, *J* = 1.3) and 7.17 d (0.5H, *J* = 1.3, =CHN); 10.77 br. s (1H, NH). ^{13}C NMR spectrum δ, ppm: 14.5 and 14.7, 15.4 and 15.8, 33.0 and 33.3, 47.5 and 47.7, 57.7, 64.8, 76.9, 110.9, 111.7, 118.2, 120.4, 120.6, 123.4, 125.6, 136.5,

210.2. Found, %: C 75.29; H 8.32; N 11.90. $C_{22}H_{29}N_3O$. Calculated, %: C 75.21; H 8.26; N 11.96.

2-(1'-Methyl-3'-indolyl)-5,7-dipropyl-6-oxo-1,3-diazaadamantane (21) was synthesized from 5,7-dipropyl-9-oxo-3,7-diazabicyclo[3.3.1] nonane and 1-methylindolyl-3-aldehyde. Yield 2.2 *g* (61%), R_f 0.70, mp. 225°C. IR spectrum, ν, cm^{-1}: 1610 (C=C_{arom}), 1708 (C=O). ^{1}H NMR spectrum, δ, ppm, *Hz*: 0.78 t (3H, *J* = 6.8) and 0.97 t (3H, *J* = 6.8, 2×$CH_2CH_2\underline{CH_3}$); 1.02-1.20 m (4H) and 1.26-1.40 m (4H, 2×$\underline{(CH_2)_2}CH_3$); 2.50 s (3H, CH_3); 2.78 br. d (2H, *J* = 12.6, NCH_2); 3.20 br. d (2H, *J* = 12.6, NCH_2); 3.35-3.54 m (4H, 2×NCH_2); 5.35 s (1H, NCHN); 6.78 ddd (1H, *J* = 8.0, 7.0, 1.1, H_{arom}); 6.88 ddd (1H, *J* = 8.1, 7.0, 1.2, H_{arom}); 7.20 br. d (1H, *J* = 8.1), 7.92 d (1H, *J* = 8.0, H_{arom}); 10.56 br. s (1H, H_{arom}). ^{13}C NMR spectrum δ, ppm: 12.9 (CH_3), 14.5 (CH_3), 14.7 (CH_3), 15.4 (CH_2), 15.7 (CH_2), 33.1 (CH_2), 33.3 (CH_2), 47.3 (CH_2), 47.7 (CH_2), 58.0 (C^*), 64.5 (C^*), 77.2 (CH_2), 77.9 (CH_2), 78.0 (CH_2), 106.1 (C^*), 109.6 (C^*), 117.8 (C^*), 119.8 (C^*), 120.5 (C^*), 127.5 (CH), 127.1 (CH), 132.8 (CH), 135.2 (CH), 210.4 (CH). Found, %: C 75.69; H 8.55; N 11.56. $C_{23}H_{31}N_3O$. Calculated, %: C 75.61; H 8.49; N 11.50.

2-(1'-Ethyl-3'-indolyl)-5,7-dipropyl-6-oxo-1,3-diazaadamantane (22) was synthesized from 5,7-dipropyl-9-oxo-3,7-diazabicyclo[3.3.1]nonane and 1-ethylindolyl-3-aldehyde. Yield 2.3 *g* (60%), R_f 0.68, mp. 130-131°C. IR spectrum, ν, cm^{-1}: 1613 (C=C_{arom}), 1698 (C=O). ^{1}H NMR spectrum, δ, ppm, *Hz*: 0.8 t (3H, *J* = 6.8), 0.98 t (3H, *J* = 6.9, 2×$CH_2CH_2\underline{CH_3}$); 1.01-1.20 m (4H); 1.26-1.40 m (4H, 2×$\underline{(CH_2)_2}CH_3$); 1.41-1.52 m (3H, CH_3); 2.81 br. d (2H, *J* = 12.5, NCH_2); 3.20 br. d (2H, *J* = 13.9, NCH_2); 3.5 br. d (4H, *J* = 13.9, 2×NCH_2); 4.21 dd (2H, *J* = 7.1, 3.4, NCH_2); 5.31 s (1H, NCHN); 6.90 dd (1H, *J* = 7.1, 5.9, H_{arom}); 7.06 dd (1H, *J* = 7.1, 5.8, H_{arom}); 7.18 s (1H, H_{arom}); 7.26 d (1H, *J* = 12.5, H_{arom}); 7.82 d (1H, *J* = 12.5, H_{arom}). ^{13}C NMR spectrum δ, ppm: 14.4, 14.7, 15.0, 15.4, 15.7, 32.9, 33.3, 40.1, 47.4, 47.6, 57.7, 64.7, 76.8, 95.5, 108.5, 111.5, 118.4, 120.7, 125.9, 126.2, 135.8, 210.0. Found, %: C 76.6; H 8.77; N 11.14. $C_{24}H_{33}N_4O$. Calculated, %: From 76.00; H 8.70; N 11.08.

2-(1'-Ethyl-2'-methyl-3'-indolyl)-5,7-dipropyl-6-oxo-1,3-diazaadamantane (23) was synthesized from 5,7-dipropyl-9-oxo-3,7-diazabicyclo[3.3.1]nonane and 1-ethyl-2-methylindolyl-3-aldehyde. Yield 2.4 *g* (61%), R_f 0.68, mp. 152-153°C. IR spectrum, ν, cm^{-1}: 1605 (C=C_{arom}), 1693 (C=O). ^{1}H NMR spectrum, δ, ppm, *Hz*: 0.8 t (3H, $(CH_2)_2\underline{CH_3}$); 0.97 t (3H, $\underline{CH_3}C_2H_4$); 1.02-1.20 m (4H, 2×NCH_2), 1.23-1.38 m (4H, $\underline{(CH_2)_2}$ and 3H, CH_3); 2.60 s (3H, CH_3); 2.80 br. d (2H, *J* = 13.5, NCH_2); 3.20 br. d (2H, *J* = 12.9, NCH_2); 3.38 br. d (2H, *J* = 12.9, NCH_2); 3.56 br. d (2H, NCH_2); 4.18 dd (2H, *J* = 12.5, 3.4, $\underline{CH_2}CH_3$); 5.38 s (1H, NCHN); 6.82 dd (1H, *J* = 7.1, 3.4, H_{arom}); 7.0 dd (1H, *J* = 7.1, 3.4, H_{arom}); 7.20 d (1H, *J* = 5.9, H_{arom}); 7.90 d (1H, *J* = 5.9, H_{arom}). ^{13}C NMR spectrum δ, ppm: 10.4, 14.4, 14.7,

15.6, 15.7, 32.9, 33.7, 36.6, 38.9, 47.3, 57.9, 64.4, 77.9, 95.5, 106.7, 107.7, 118.3, 119.9, 121.1, 126.4, 132.9, 135.1, 210.1. Found, %: C 76.39; H 8.96; N 10.74. $C_{25}H_{35}N_3O$. Calculated, %: C 76.33; H 8.90; N 10.68.

2-(1',2'-Dimethyl-3'-indolyl)-5,7-dipropyl-6-oxo-1,3-diazaadamantane (24) was synthesized from 5,7-dipropyl-9-oxo-3,7-diazabicyclo[3.3.1]nonane and 1,2-dimethylindolyl-3-aldehyde. Isomer 50:50. Yield 2.3 *g* (60%), R_f 0.76 , m.p. 167-168°C. IR spectrum, ν, cm^{-1}: 1608 (C=C_{arom}), 1698 (C=O). ^{1}H NMR spectrum, δ, ppm, *Hz*: 0.79 t (3H, *J* = 6.8) and 0.97 t (3H, *J* = 6.0, 2×$CH_2CH_2\underline{CH_3}$); 1.01-1.19 m (4H) and 1.28-1.40 m (4H, 2×$(\underline{CH_2})_2CH_3$); 2.58 s (1.5H) and 2.59 s (1.5H, CH_3); 2.78 br. d (2H, *J* = 12.6, NCH_2); 3.20 br. d (2H, *J* = 12.6, NCH_2); 3.35-3.43 m (2H) and 3.50-3.58 m (2H, 2×$N\underline{CH_2}$); 3.69 s (3H, NCH_3); 5.35 br. s (1H, NCHN); 6.86 ddd (1H, *J* = 8.0, 7.0, 1.1), 7.01 ddd (1H, *J* = 8.1, 7.0, 1.2), 7.20 br. d (1H, *J* = 8.1) and 7.93 br. d (1H, *J* = 8.0, H_{arom}). ^{13}C NMR spectrum δ, ppm: 10.7, 14.4, 14.7, 15.4, 15.7, 28.6, 33.0, 33.3, 47.2, 47.6, 57.9, 64.4, 77.8, 106.6, 107.7, 118.4, 119.9, 121.0, 126.2, 133.8, 136.3, 210.2. Found, %: C 76.05; H 8.75; N 11.14. $C_{24}H_{33}N_3O$. Calculated, %: C 75.98; H 8.70; N 11.08.

2-(1'-Benzyl-3'-indolyl)-5,7-dipropyl-6-oxo-1,3-diazaadamantane (25) was synthesized from 5,7-dipropyl-9-oxo-3,7-diazabicyclo[3.3.1] nonane and 1-benzylindolyl-3-aldehyde. Yield 2.6 *g* (59%), R_f 0.71, m.p. 157-158°C. IR spectrum, ν, cm^{-1}: 1601 (C=C_{arom}), 1690 (C=O). ^{1}H NMR spectrum, δ, ppm, *Hz*: 0.79 t (3H, *J* = 6.8, CH_3); 0.98 t (3H, *J* = 6.1, CH_3); 1.02-1.19 m (4H, $\underline{CH_2CH_2}CH_3$); 1.25-1.41 m (4H, $\underline{CH_2CH_2}CH_3$); 2.75 br. d (2H, *J* = 12.5), 3.18 br. d (2H, *J* = 12.5), 3.54 br. d (4H, *J* = 12.5, 4×NCH_2); 5.32 br. s (2H, $\underline{CH_2}C_6H_5$); 5.32 s (1H, NCHN); 6.88 -7.25 m (9H, H_{arom}); 7.84 d (0.5H, *J* = 1.3); 7.88 d (0.5H, *J* = 1.3, =CHN). ^{13}C NMR spectrum δ, ppm: 14.5 and 14.7, 15.4 and 15.7, 33.0 and 33.2, 47.5 and 47.7, 49.2, 57.5, 64.7, 76.6, 109.1, 112.0, 118.6, 121.0, 121.1, 126.2, 126.3, 126.8, 127.2, 128.0, 136.4, 136.5, 137.5, 209.9. Found, %: C 78.97; H 8.0; N 9.59. $C_{29}H_{35}N_3O$. Calculated, %: C 78.91; H 9.3; N 9.52.

2-(1'-Benzyl-2'-methyl-3'-indolyl)-5,7-diethyl-6-hydroxy-1,3-diazaadamantane (26) was synthesized from 5,7-diethyl-9-hydroxy-3,7-diazabicyclo[3.3.1]nonane and 1-benzyl-2-methylindolyl-3-aldehyde. Yield 2.6 *g* (61%), R_f 0.80, mp. 120-121°C. IR spectrum, ν, cm^{-1}: 1619 (C=C_{arom}), 3521 (OH). ^{1}H NMR spectrum, δ, ppm, *Hz*: 0.66 t (3H, *J* = 7.2, CH_3); 0.85 dd (4H, *J* = 7.1, 5.9, 2×NCH_2); 1.05 t (3H, *J* = 7.5, CH_3); 1.38 dq (1H, *J* = 12.9, 7.5, NCH_2); 2.45 s (3H, CH_3); 2.58 dd (1H, *J* = 12.9, 3.1, NCH_2); 2.65 d (1H, *J* = 12.8, NCH_2); 2.98-3.08 m (2H, NCH_2); 3.18 d (1H, *J* = 5.8, NCH_2); 3.38 dd (1H, *J* = 12.8, 3.1, NCH_2); 3.55 d (1H, *J* = 5.87, OCH); 3.55 d (1H, *J* = 5.9, NCH_2); 4.12 d (1H, *J* = 5.4, $CH\underline{OH}$); 5.11 d (1H, NCHN); 5.3 s (2H, $\underline{CH_2}C_6H_5$); 6.80-6.96 m (4H, H_{arom}); 7.1-7.28 m (4H, H_{arom}); 8.08 d (1H, *J* = 5.9, H_{arom}). ^{13}C NMR spectrum δ, ppm: 5.8, 5.9, 10.4, 18.2, 25.5,

25.7, 31.3, 31.4, 45.2, 50.5, 54.1, 56.0, 58.2, 61.5, 78.4, 95.5, 107.6, 108.9, 119.3, 119.9, 121.7, 125.2, 126.3, 126.9, 128.0, 133.5, 136.1, 137.9. Found, %: C 78.38; H 8.20; N 9.72. $C_{29}H_{35}N_3O$. Calculated, %: C 78.32; H 8.15; N 9.79.

2-(6'-Chloro-3'-indolyl)-5,7-dimethyl-6-hydroxy-1,3-diazaadamantane (27) was synthesized from 5,7-dimethyl-9-hydroxy-3,7-diazabicyclo[3.3.1]nonane and 6-chloroindolyl-3-aldehyde. Yield 2.1 *g* (63%), R_f 0.25, mp. 250-25°C. IR spectrum, ν, cm^{-1}: 1618 (C=C_{arom}), 3301 (NH), 3325 (OH). ^{1}H NMR spectrum, δ, ppm, *Hz*: 0.42 s (3H, CH_3); 0.68 s (3H, CH_3); 2.71-3.20 m (8H, 4×NCH_2); 3.38 dd (1H, *J* = 5.8, 5.9, CHOH); 4.41 d (1H, *J* = 5.9, CHOH); 5.02 s (1H, NCHN); 6.82 d (1H, *J* = 8.0, H_{arom}); 7.10 s (1H, H_{arom}); 7.22 s (1H, H_{arom}), 7.82 d (1H, =CHN); 10.78 br. s (1H, NH). ^{13}C NMR spectrum δ, ppm: 19.9, 20.2, 30.1, 50.2, 57.3, 58.4, 65.0, 76.7, 79.0, 110.3, 113.5, 118.2, 121.9, 124.1, 124.5, 125.6, 136.7. Found, %: C 65.21; H 6.61; N 12.60; Cl 10.76. $C_{18}H_{22}N_3ClO$. Calculated, %: C 65.15; H 6.55; N 12.66; Cl 10.70.

2-(2'-Methyl-3'-indolyl)-5,7-diethyl-6-hydroxy-1,3-diazaadamantane (28) was synthesized from 5,7-diethyl-9-hydroxy-3,7-diazabicyclo[3.3.1] nonane and 2-methylindolyl-3-aldehyde. Yield 2.1 *g* (62%), R_f 0.79, mp. 235-236°C. IR spectrum, ν, cm^{-1}: 1610 (C=C_{arom}), 3310 (NH), 3521 (OH). ^{1}H NMR spectrum, δ, ppm, *Hz*: 0.65 t (3H, *J* = 7.2, CH_3); 0.85 t (3H, *J* = 7.5, CH_3); 0.68 m (1H) and 1.31 dc (1H, *J* = 13.9, 7.5, CH_2); 1.03-1.23 m (2H, CH_2); 2.46 s (3H, CH_3); 2.58 dd (1H, *J* = 13.1, 3.1, NCH_2); 2.69 dt (1H, *J* = 12.8, 1.4, NCH_2); 2.81-2.90 m (2H, NCH_2); 2.98 dd (1H, *J* = 13.1, 2.2, NCH_2); 3.02 dd (1H, *J* = 13.1, 3.1, NCH_2); 3.15 dd (1H, *J* = 13.0, 2.3, NCH_2); 3.34 dd (1H, *J* = 12.8, 3.1, NCH_2); 3.54 d (1H, *J* = 5.9, OCH); 4.12 d (1H, *J* = 5.4, CHOH); 5.03 d (1H, NCHN); 6.75 ddd (1H, *J* = 8.1, 7.1, 1.3, H_{arom}); 6.85 ddd (1H, *J* = 8.1, 7.1, 1.3, H_{arom}); 7.12 d (1H, *J* = 7.9, H_{arom}); 7.88 d (1H, *J* = 8.1, H_{arom}); 10.27 br. s (1H, NH). ^{13}C NMR spectrum δ, ppm: 5.4, 5.8, 12.8, 25.5, 25.6, 31.2, 31.3, 50.7, 54.2, 58.2, 61.5, 72.8, 78.6, 107.6, 109.3, 117.5, 119.0. Found, %: C 74.39; H 8.61; N 12.43. $C_{21}H_{29}N_3O$. Calculated, %: C 74.33; H 8.55; N 12.38.

2-(5'-Methoxy-3'-indolyl)-5,7-dimethyl-6-hydroxy-1,3-diazaadamantane (29) was synthesized from 5,7-dimethyl-9-hydroxy-3,7-diazabicyclo[3.3.1]nonane and 5-methoxyindolyl-3-aldehyde. Yield 2.0 *g* (60%), R_f 0.79, mp. 256-257°C. IR spectrum, ν, cm^{-1}: 1627 (C=C_{arom}), 3142 (OH), 3308 (NH). ^{1}H NMR spectrum, δ, ppm, *Hz*: 0.43 s (3H, CH_3); 0.68 s (3H, CH_3); 2.86 br. s (6H, 3×NCH_2); 3.11-3.20 m (3H, NCH_2, 1H, OH); 3.96 s (3H, OCH_3); 4.38 d (1H, *J* = 5.8, CHOH); 5.01 s (1H, NCHN); 6.48 d (1H, *J* = 5.9, H_{arom}); 6.76 ddd (1H, *J* = 8.0, 7.0, 1.0, H_{arom}); 7.01 s (1H, H_{arom}); 7.42 d (1H, *J* = 8.0, H_{arom}); 10.60 br. s (1H, NH). ^{13}C NMR spectrum δ, ppm: 20.0, 20.2, 30.1, 30.2, 50.2, 54.5, 57.3, 58.5, 65.1, 76.9, 79.2, 100.6, 113.7,

114.2, 118.0, 123.1, 126.4, 127.4, 145.4, Found, %: C 69.77; H 7.71; N 12.78. $C_{19}H_{25}N_3O_2$. Calculated, %: C 69.72; H 7.64; N 12.84.

2-(2'-Methyl-3'-indolyl)-5,7-dimethyl-1,3-diazaadamantane (30) was synthesized from 5,7-dimethyl-3,7-diazabicyclo[3.3.1]nonane and 2-methylindolyl-3-aldehyde. Yield 2.0 *g* (67%), R_f 0.67, mp. 199-200°C. IR spectrum, ν, cm^{-1}: 1610 (C=C_{arom}), 3315 (NH). ^{1}H NMR spectrum, δ, ppm, *Hz*: 0.43 s (3H, CH_3); 0.68 s (3H, CH_3); 1.48 s (2H, NCH_2); 2.95-3.21 m (11H, 4×NCH_2 and CH_3); 5.08 s (1H, NCHN); 6.68 ddd (1H, *J* = 8.0, 7.0, 1.1, H_{arom}); 6.85 ddd (1H, *J* = 8.1, 7.0, 1.2, H_{arom}); 7.12 br. d (1H, *J* = 8.1, H_{arom}); 7.86 d (1H, *J* = 8.0, H_{arom}); 10.38 br. s (1H, NH). Found, %: C 77.35; H 8.53; N 14.30. $C_{19}H_{25}N_3$. Calculated, %: C 77.29; H 8.47; N 14.23.

2-(1',2'-Dimethyl-3'-indolyl)-5,7-dimethyl-1,3-diazaadamantane (31) was sinthesized from 5,7-dimethyl-3,7-diazabicyclo[3.3.1]nonane and 1,2-dimethylindolyl-3-aldehyde. Yield 2.0 *g* (67%), R_f 0.73, mp. 260 subl. °C. IR spectrum, ν, cm^{-1}: 1608 (C=C_{arom}). ^{1}H NMR spectrum, δ, ppm, *Hz*: 0.43 s (3H, CH_3); 0.68 s (3H, CH_3); 1.46 br. s (2H, NCH_2); 2.60 br. s (3H, CH_3); 2.78 br. s (2H, NCH_2); 3.20 br. d (6H, *J* = 12.5, 3×NCH_2); 3.66 s (3H, NCH_3); 5.12 s (1H, NCHN); 6.81 ddd (1H, *J* = 8.0, 7.1, 1.1, H_{arom}); 6.98 ddd (1H, *J* = 8.1, 7.1, 1.2, H_{arom}); 7.18 br. d (1H, *J* = 8.1, H_{arom}); 7.93 br. d (1H, *J* = 8.1, H_{arom}). Found, %: C 77.55; H 8.75; N 13.59. $C_{20}H_{27}N_3$. Calculated, %: C 77.48; H 8.70; N 13.54.

ԻՆԴՈԼԱՅԻՆ ՀԱՏՎԱԾ ՊԱՐՈՒՆԱԿՈՂ 1,3-ԴԻԱԶԱԱԴԱՄԱՆՏԱՆՆԵՐՋ ՍԻՆԹԵԶԸ ԵՎ ԴՐԱՆՑ ՀԱԿԱՕՔՍԻԴԱՆՏԱՅԻՆ ՀԱՏԿՈՒԹՅՈՒՆՆԵՐԻ ՈՒՍՈՒՄՆԱՍԻՐՈՒԹՅՈՒՆԸ

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9-Հիդրօքսի-, 9-օքսո-, 1,5-դիալկիլ-3,7-դիազաբիցիկլո[3.3.1]նոնանների և տարբեր տեղակալիչներով (ալկիլ, ալկօքսի, բենզիլ, հալոգեն) ինդոլ-3-ալդեհիդների կոնդենսմամբ սինթեզվել են նոր 2-տեղակալված 1,3-դիազաադամանտաններ: Ստացված միացությունների հակաօքսիդանտային հատկությունների ուսումնասիրությունը ցույց է տվել, որ դրանցից որոշները ցուցաբերել են ցածր և միջին ակտիվություն: Դրանք այն միացություններն են, որոնց դիազաադամանտանային օղակի 6-րդ դիրքում առկա է հիդրօքսիլ խումբ:

СИНТЕЗ И ИЗУЧЕНИЕ АНТИОКСИДАНТНОЙ АКТИВНОСТИ НЕКОТОРЫХ 2-ЗАМЕЩЕННЫХ 1,3-ДИАЗААДАМАНТАНОВ, СОДЕРЖАЩИХ ИНДОЛЬНЫЙ ФРАГМЕНТ

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Конденсацией 9-гидрокси-, 9-оксо-, 1,5-диалкил-3,7-диазабицикло[3.3.1]нонанов с различными индол-3-альдегидами синтезирован новый ряд 1,3-диазаадамантанов и исследована их антиоксидантная активность. Согласно результатам проведенных биологических испытаний, некоторые производные этого ряда обладают слабой и умеренной антиоксидантной активностью, особенно соединения, содержащие в 6-ом положении диазаадамантаного кольца гидроксильную группу.

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