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Indole-Containing Derivatives of α-Pyrrolidone: Synthesis and Structure

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Abstract—4-(Indol-3-yl)-2-pyrrolidone and its derivatives have been synthesized via sequential hydrogenation of indole-containing esters of 4-nitrobutanoic acid, alkaline hydrolysis of the resulting 3-methoxycarbonyl-2-pyrrolidones, and decarboxylation of the isolated 2-pyrrolidone-3-carboxylic acids. Structures of the products have been confirmed by IR, ^{1}H NMR, ^{1}H–^{13}C HMQC, and ^{1}H–^{1}H NOESY spectroscopy methods.

Keywords: 2-pyrrolidone, pyrrolidone carboxylate, catalytic hydrogenation, heterocyclization, alkaline hydrolysis, decarboxylation

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2-Pyrrolidone and indole have been recognized as important pharmacophore fragments of many biologically active natural compounds and synthetic drugs. For example, nootropics piracetam [2] and fenotropil (Carphedon) [1, 3, 4] as well as entero-sorbents based on polyvinylpyrrolidone (Enterodez) [2] contain pyrrolidone rings. Widely used indopan (antidepressant), diazolin (antihistamine), indomethacin (anti-inflammatory drug), and bopindalol (used for treatment of angina and hypertension) are examples of indole-containing synthetic drugs [2]. Therefore, the indole-containing 2-pyrrolidones are among the key structures in targeted synthesis of various pharmacologically active substances.

The indole-containing 2-pyrrolidones can be obtained via a general procedure of 4-aminobutyric acid and 2-pyrrolidones synthesis based on preparation of the corresponding 4-nitrobutanoates followed by their hydrogenation in neutral or alkaline media to yield the substituted 2-pyrrolidones [1, 4, 5].

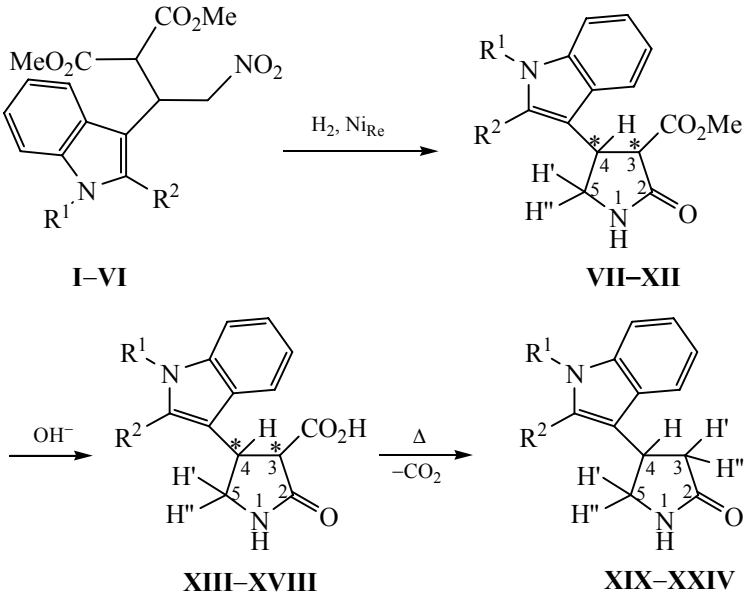
We carried out hydrogenation of nitroesters **I–VI** with electrolytic hydrogen on Raney nickel (atmospheric pressure, 18–20°C) in methanol or a 1 : 1 acetone–methanol mixture. The 4-nitrobutanoates **I–VI** were obtained via condensation of nitroethenes with malonic ester as described earlier [6–8].

Reduction of compounds **I–VI** was accompanied by intramolecular acylation of the initially formed amino group to give 4-(indol-3-yl)-3-methoxycarbonyl-2-pyrrolidone **VII** and its analogs **VIII–XII** in high yields (70%). Noteworthily, synthesis of compound **VII** has been described earlier [6]; however, the product melting point reported in [6] significantly deviated from that determined in this work.

The indole-containing pyrrolidone carboxylates **VII–XII** were stable colorless crystalline solids; they are valuable precursors in preparation of the corresponding 4-aminobutyric acids, pyrrolidone carboxylic acids, and 2-pyrrolidones. In particular, boiling of compounds **VII–XII** in 10% sodium hydroxide aqueous methanol (1 : 10) solution during 10 min resulted in hydrolysis of the ester group to give 4-(indol-3-yl)-3-hydroxycarbonyl-2-pyrrolidone **XIII** and its derivatives **XIV–XVIII** in good yields (see table). Importantly, under the reaction conditions the pyrrolidone ring was not opened. Subsequent heating of compounds **XIII–XVIII** above their melting point under reduced pressure yielded the target indole-containing 2-pyrrolidones **XIX–XXIV** (Scheme 1).

Structures of the 2-pyrrolidones **VII–XXIV** were confirmed by IR, ^{1}H NMR, and ^{13}C NMR spectro-

Scheme 1.



I–VI **VII–XII**

XIII–XVIII **XIX–XXIV**

R^1 = H: R^2 = H (**I, VII, XIII, XIX**), CH_3 (**II, VIII, XIV, XX**); R^1 = CH_3: R^2 = H (**III, IX, XV, XXI**), CH_3 (**IV, X, XVI, XXII**); R^1 = CH_2Ph: R^2 = H (**V, XI, XVII, XXIII**), CH_3 (**VI, XII, XVIII, XXIV**).

scopy methods (see table). The obtained parameters were in good agreement with those for compound **VII** [9], and compounds **XIII** and **XIX** produced via different methods [10–13]. For example, IR spectra of pyrrolidone carboxylates **VII**–**XII** contained absorption bands assigned to the ester (1745–1730 cm^{-1}) and the lactam (1705–1685 cm^{-1}) carbonyl groups; the spectra of pyrrolidone carboxylic acids **XIII**–**XVIII** contained broadened absorption bands (1712–1613 cm^{-1}) due to overlapping stretching bands of lactam and carboxyl groups. In the case of 4-aryl(hetaryl)-2-pyrrolidones **XIX**–**XXIV**, that band was shifted to lower frequency (1693–1679 cm^{-1}) (see table), characteristic of the lactam carbonyl group stretching [14]. NH-Pyrrolidone groups (compounds **VII**–**XXIV**) and indole moieties (compounds **VII**, **VIII**, **XIII**, **XIX** , **XIX**, and **XX**) gave rise to absorption bands at 3315–3185 and 3415–3350 cm^{-1}, respectively.

^{1}H NMR spectra of compounds **VII**–**XVIII** (see table) containing two chiral centers confirmed their diastereo homogeneity. For example, the methine proton signals of pyrrolidone ring appeared as a doublet of triplets [4.07 ppm (C^4H)] and a doublet [3.55 ppm (C^3H), $^3J_{34}$ 10.7 Hz] in the ^{1}H NMR spectrum of pyrrolidone carboxylic acid **XIV**; the methylene protons resonated as triplets [3.42, 3.51 ppm (S5N'H"), (C^5H'H"), $^3J_{45'}$ 9.1, $^3J_{45"}$ 9.1, $^2J_{5'5"}$ 9.1 Hz]. Magnetic nonequivalence of the methylene protons could be apparently explained by the presence of adjacent asymmetric carbon atoms [15]. The signals of carboxyl OH groups (12.52 ppm), pyrrolidone NH (8.12 ppm) and indole NH (10.84 ppm) moieties appeared as weak-field singlets. The indole ring protons were assigned to a multiplet at 6.89–7.42 ppm. The singlet at 2.29 ppm corresponded to the methyl group at the C^2 atom of the indole ring.

Assignments of the signals of methine and methylene protons of pyrrolidone rings in the spectra of 2-pyrrolidones were verified taking advantage of 2D NMR spectroscopy technique. In particular, the correlations were revealed between the protons C^4H (4.07 ppm) and the C^4 atom (36.97 ppm) as well as between the C^3H (3.55 ppm) and C^3 (54.63 ppm) as well as C^5H_2 (3.42, 3.51 ppm) and C^5 (45.51 ppm) atoms in the HMQC spectrum of **XIV** (Fig. 1). The HMQC spectrum allowed distinguishing the proton signals of C^3H, C^4H, and C^5H_2 atoms of the pyrrolidone ring and showed that the C^4H proton signal appeared in a weaker field region as compared to that of the C^3H proton signal (Fig. 1); that coincided with the earlier published data [16] and was apparently explained by the presence of indole ring at the C^4 atom.

^{1}H NMR spectrum of 4-(1-methylindol-3-yl)-2-pyrrolidone **XXI** contained a multiplet assigned to the

Yields, melting points, and spectral parameters of compounds **VII**–**XXIV**

Comp. no.	Yield, %	mp, °C	ν, cm^{-1}		δ_H, ppm						*J*, Hz			
			NH (NH_{Ind})	CO_2Me, C=O	Ind, (R^1), [R^2]	C^3H, C^3H' (C^3H'')	C^4H	C^5H' (C^5H'')	NH (NH_{Ind})	CH_3 (OH)	$J_{3'3''}$	J_{34} ($J_{3'4}$, $J_{3''4}$)	$J_{45'}$ ($J_{45''}$)	$J_{5'5''}$
VII	74	185–186	3215 (3395)	1745, 1703	6.94–7.48	3.60	4.12	3.31 (3.67)	8.14 (10.95)	3.59	–	10.2	9.2 (9.2)	9.2
VIII	70	190–192	3258 (3415)	1737, 1685	6.87–7.41, [2.31]	3.65	4.12	3.46 (3.55)	8.12 (10.74)	3.58	–	11.0	9.2 (9.2)	9.2
IX	65	191–193	3213	1742, 1700	6.99–7.51, (3.69)	3.58	4.11	3.31 (3.68)	8.17	3.60	–	10.0	9.0 (9.0)	9.0
X	70	217–219	3199	1740, 1705	6.95–7.51, (3.55), [2.31]	3.71	4.14	3.45 (3.52)	8.22	3.59	–	10.9	9.2 (9.2)	9.2
XI	60	110–112	3205	1734, 1694	6.98–7.46, (6.98–7.46, 5.31)	3.53	4.11	3.36 (3.67)	8.10	3.62	–	10.3	8.9 (8.9)	8.9
XII	70	201–203	3218	1730, 1695	6.92–7.56, (6.92–7.56, 5.35), [2.27]	3.72	4.16	3.50 (3.59)	8.22	3.55	–	10.9	9.3 (9.3)	9.3
XIII	91	152–153	3314 (3409)	1710–1675	6.94–7.51	3.44	4.08	3.28 (3.65)	8.06 (10.95)	(12.62)	–	10.4	8.8 (8.8)	8.8
XIV	87	177–179	3283 (3397)	1710–1665	6.89–7.42, [2.29]	3.55	4.07	3.42 (3.51)	8.12 (10.84)	(12.52)	–	10.7	9.1 (9.1)	9.1
XV	85	165–166	3293	1712–1645	6.98–7.52 (3.70)	3.41	4.08	3.28 (3.65)	8.08	(12.65)	–	10.3	9.0 (9.0)	9.0
XVI	82	193–195	3205	1710–1658	6.95–7.47 (3.60), [2.31]	3.57	4.12	3.47 (3.57)	8.14	(12.53)	–	10.7	9.2 (9.2)	9.2
XVII	88	100–102	3227	1700–1677	6.97–7.50, (6.97–7.50, 5.32)	3.44	4.10	3.30 (3.68)	8.09	(12.67)	–	10.3	8.9 (8.9)	8.9
XVIII	83	168–170	3231	1700–1660	6.93–7.52 (6.93–7.52, 5.34, 5.39), [2.28]	3.59	4.15	3.49 (3.58)	8.15	(12.56)	–	10.6	9.2 (9.2)	9.2
XIX	74	179–180	3315 (3350)	1679	6.94–7.49	2.33 (2.54)	3.78	3.24 (3.65)	7.67 (10.86)	–	16.3	9.0 (8.7)	8.8 (7.8)	8.8
XX	62	182–184	3270 (3390)	1679	6.87–7.38, [2.30]	(2.42)	3.79	3.37 (3.49)	7.75 (10.74)	–	–	–	9.0 (7.9)	9.0
XXI	85	170–172	3185	1685	7.03–7.48, (3.67)	2.30 (2.55)	3.95	3.21 (3.64)	7.67	–	16.3	8.8 (8.7)	8.8 (7.5)	8.8
XXII	79	193–195	3209	1693	6.92–7.41, (3.59), [2.32]	(2.41)	3.85	3.38 (3.49)	7.78	–	–	–	9.1 (7.9)	9.1
XXIII	83	165–167	3214	1686	6.97–7.52, (6.97–7.52, 5.31)	2.32 (2.56)	3.80	3.25 (3.68)	7.67	–	16.3	8.9 (8.7)	8.8 (7.5)	8.8
XXIV	72	88–90	3245	1692	6.93–7.46, (6.93–7.46, 5.34), [2.28]	(2.45)	3.88	3.42 (3.52)	7.80	–	–	–	9.2 (7.8)	9.2

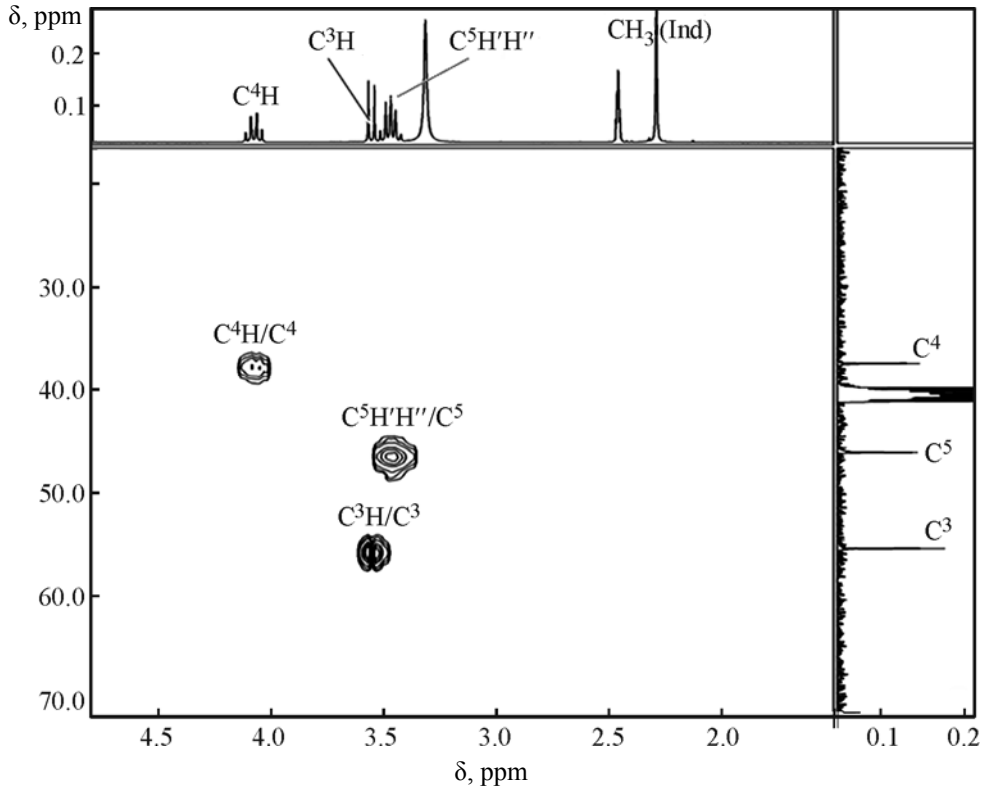
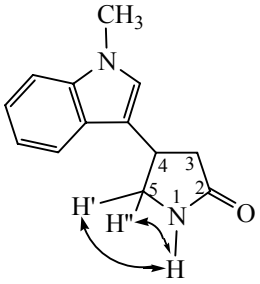


Fig. 1. Fragment of $^{1}H–^{13}C$ HMQC spectrum of compound **XIV** in DMSO-d_6.

C^4H methine proton (3.95 ppm) of the pyrrolidone ring; the signals of the $C^3H'H''$ methylene group protons (2.30, 2.55 ppm, $^2J_{3'3''}$ 16.3, $^3J_{3'4}$ 8.8, $^3J_{3''4}$ 8.7 Hz) appeared as doublets of doublets. The $C^5H'H''$ protons resonated as a triplet [3.21 ppm (C^5H'), $^3J_{45'}$ 8.8, $^2J_{5'5''}$ 8.8 Hz] and a doublet of doublets [3.64 ppm C^5H''), $^3J_{45''}$ 7.5, $^2J_{5'5''}$ 8.8 Hz]. The singlet at 7.67 ppm was assigned to the NH-proton of lactam group. The signals of the indole fragment protons were detected at 7.03–7.48 ppm. The protons of the N-methyl group of the indole ring gave rise to a strong-field singlet (3.67 ppm).



Assignment of the signals of C^3H and C^5H methylene protons of pyrrolidone ring was aided by heteronuclear NMR spectroscopy. In particular, the correlations between the signals of the C^4H (3.95 ppm) and C^4 (32.82 ppm), $C^3H'H''$ (2.30, 2.55 ppm) and C^3 (37.81 ppm), $C^5H'H''$ (3.21, 3.64 ppm) and C^5 (48.55 ppm) atoms were found in the HMQC spectrum of compound **XXI** (Fig. 2). Validity of signal assignment of the C^3 and C^5 methylene groups of the pyrrolidone ring was confirmed by NOESY spectroscopy. In detail, the correlation between the signals of the lactam NH proton (7.67 ppm) and the $C^5H'H''$ methylene protons (3.21 ppm) was revealed in the spectrum of compound **XXI** (Fig. 3), indicating the spatial proximity of those protons. Consequently, assignment of the signals at δ 2.30 and 2.55 ppm to the C^3 methylene protons of the pyrrolidone ring was correct. Hence, taking the NMR spectrum of compound **VII** as a model one and analyzing the 2D NMR spectra of compounds **XIV** and **XXI**, we could assign ^1H NMR spectra of all the prepared compounds **VII**–**XXIV** (see table).

The synthesized 2-pyrrolidones are valuable starting materials for preparation of indole-containing derivatives of γ-aminobutyric acid and piracetam. Furthermore, they are of interest as potentially biologically active compounds. For example, 4-(indol-

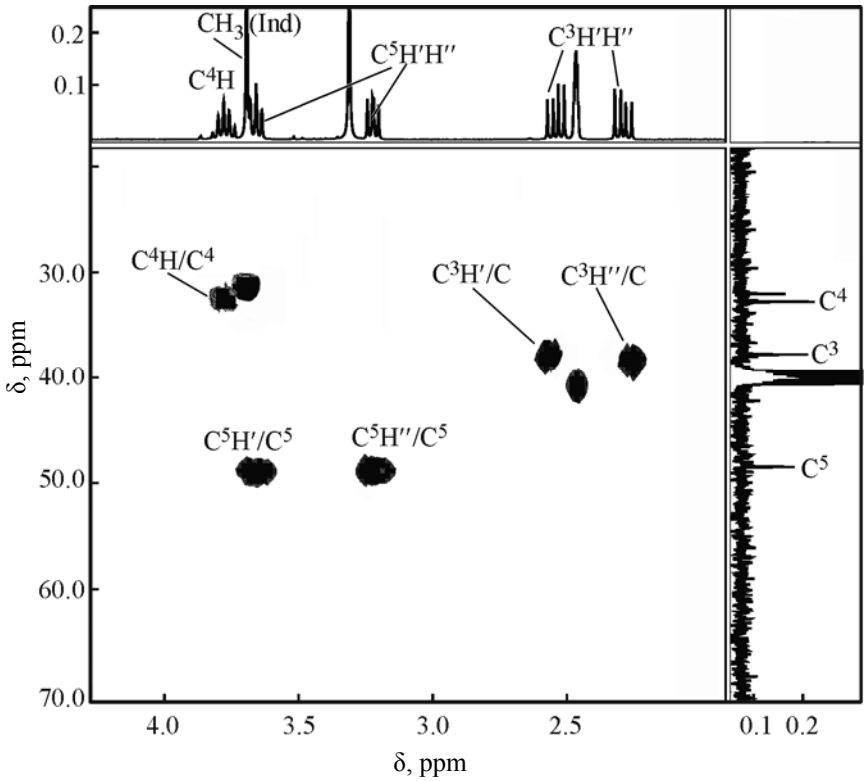


Fig. 2. Fragment of $^{1}H–^{13}C$ HMQC spectrum of compound **XXI** in DMSO-d_6.

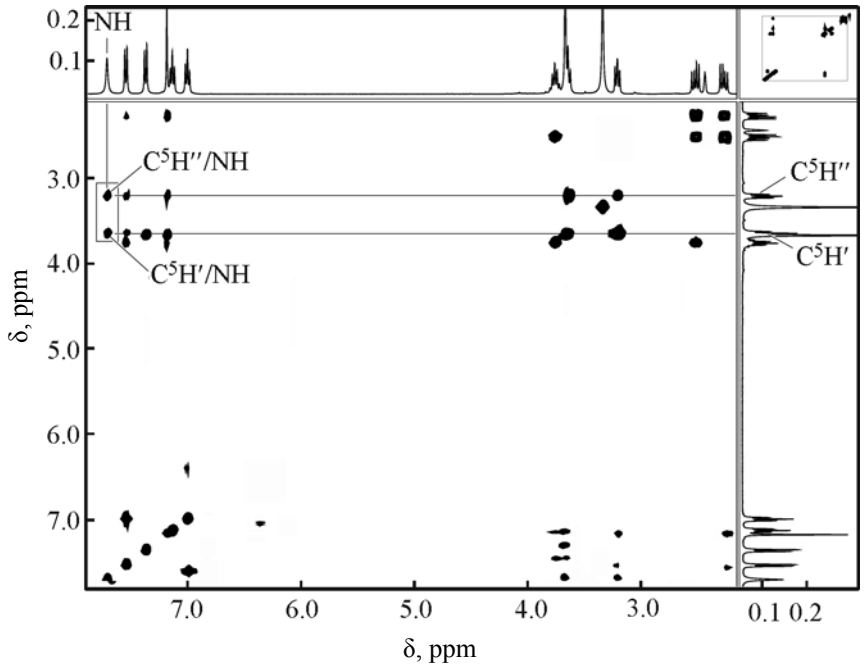


Fig. 3. $^{1}H–^{1}H$ NOESY spectrum of compound **XXI** in DMSO-d_6.

3-yl)-2-pyrrolidone **XIX** exhibited pronounced hypotensive action in experiments with anaesthetized rats, however, inhibiting breathing when applied in the effective dose. The same compound caused a dose-dependent decrease in blood pressure in the experiments with anesthetized cats, and anti-hypertensive effect during the oral administration was much weaker than in the case of the intravenous administration.

EXPERIMENTAL

Spectral and elemental analysis data were obtained at the Center for Collective Use, Herzen State Pedagogical University of Russia.

^{1}H, ^{1}H–^{13}C HMQC NMR spectra of the solutions in DMSO-d_6 were recorded using a Jeol ECX400A spectrometer operating at 399.78 (^{1}H) and 100.525 MHz (^{13}C) relative to the signal of the residual solvent protons. IR spectra of the pellets with KBr were obtained using a Shimadzu IR Prestige-21 Fourier spectrometer. Elemental analysis was performed with a EuroVector EA 3000 analyzer (CHN Dual mode). Melting points were determined with a PTP (M) instrument.

The starting 3-(indol-3-yl)-4-nitrobutanoates **I–VI** were prepared via the known methods [6–8].

4-(Indol-3-yl)-3-methoxycarbonyl-2-pyrrolidone (VII). A suspension of 3.20 g of Raney nickel catalyst in 32 mL of methanol was saturated with hydrogen via electrolysis. A suspension of 2.88 g (0.009 mol) of methyl 3-(indol-3-yl)-2-methoxycarbonyl-4-nitrobutanoate **I** in 60 mL of methanol was then added under a hydrogen stream, and hydrogenation was carried out until uptake of the calculated amount of hydrogen [0.605 L (0.027 mol)]. The catalyst was filtered off and washed with boiling methanol via decantation (3 × 100 mL). The filtrate was evaporated under reduced pressure (15–20 mmHg) to three-quarters of the original volume. The precipitated crystalline product was filtered off and dried. Yield 1.72 g (74%), mp 185–186°C (methanol) (mp 172.5–173°C [6]). Found, %: C 65.05, 65.03; H 5.73, 5.70; N 10.98, 11.01 $C_{14}H_{14}N_2O_3$. Calculated, %: C 65.12; H 5.43; N 10.85.

Compounds **VIII**, **IX**, and **XI** were prepared similarly.

4-(2-Methylindol-3-yl)-3-methoxycarbonyl-2-pyrrolidinone (VIII). Yield 70%, mp 190–192°C (methanol). Found, %: C 66.27, 66.28; H 6.05, 6.05; N 10.25, 10.28. $C_{15}H_{16}N_2O_3$. Calculated, %: C 66.18; H 5.88; N 10.29.

4-(1-Methylindol-3-yl)-3-methoxycarbonyl-2-pyrrolidone (IX). Yield 62%, mp 191–193°C (methanol). Found, %: C 66.23, 66.25; H 5.92, 5.91; N 10.29, 10.29. $C_{15}H_{16}N_2O_3$. Calculated, %: C 66.18; H 5.88; N 10.29.

4-(1-Benzylindol-3-yl)-3-methoxycarbonyl-2-pyrrolidone (XI). Yield 60%, mp 110–112°C (methanol). Found, %: C 72.24, 72.30; H 5.58, 5.67; N 8.25, 8.05. $C_{21}H_{20}N_2O_3$. Calculated, %: C 72.41; H 5.75; N 8.05.

4-(1,2-Dimethylindol-3-yl)-3-methoxycarbonyl-2-pyrrolidone (X). A suspension of 3.70 g of Raney nickel in 37 mL of methanol was saturated with hydrogen via electrolysis. A suspension of 3.55 g of (0.01 mol) of methyl 3-(1,2-dimethylindole-3-yl)-2-methoxycarbonyl-4-nitrobutanoate **IV** in 35 mL of a 1 : 1 methanol–acetone mixture was then added under hydrogen stream. The mixture was hydrogenated until uptake of the calculated amount of hydrogen [0.672 L (0.03 mol)]. The catalyst was filtered off and washed with a boiling 1 : 1 mixture of methanol and acetone via decantation (3 × 100 mL). The filtrate was evaporated under reduced pressure (15–20 mmHg) to three-quarters of the original volume. The precipitated crystalline product was filtered off and dried. Yield 1.80 g (70%), mp 217–219°C (methanol). Found, %: C 67.10, 67.15; H 6.38, 6.36; N 9.84, 9.85. $C_{16}H_{18}N_2O_3$. Calculated, %: C 67.13; H 6.29; N 9.79.

Compound **XII** was prepared similarly.

4-(1-Benzyl-2-methylindol-3-yl)-3-methoxycarbonyl-2-pyrrolidone (XII). Yield 70%, mp 201–203°C (methanol). Found, %: C 72.19, 72.15; H 6.22, 6.23; N 7.98, 7.97. $C_{22}H_{22}N_2O_3$. Calculated, %: C 72.93; H 6.08; N 7.73.

4-(Indol-3-yl)-3-hydroxycarbonyl-2-pyrrolidone (XIII). A mixture of 14.30 mL of methanol, 1.45 mL of water, 2.00 g (0.05 mol) of sodium hydroxide, and 1.68 g (0.0065 mol) of 4-(indol-3-yl)-3-methoxycarbonyl-2-pyrrolidone **VII** was refluxed during 10 min. After cooling, the precipitate was filtered off and dissolved in 40 mL of water. The resulting solution was carefully acidified upon cooling at 0–5°C with diluted hydrochloric acid (1 : 1) to pH ~ 3–4. The precipitate was filtered off and dried. Yield 1.44 g (91%), mp 152–153°C (methanol) (mp 152.5–153°C [6]). Found, %: C 63.85, 63.80; H 5.11, 5.09; N 11.33, 11.35 $C_{13}H_{12}N_2O_3$. Calculated, %: C 63.93; H 4.95; N 11.47.

Compounds **XIV–XVIII** were obtained similarly.

4-(2-Methylindol-3-yl)-3-hydroxycarbonyl-2-pyrrolidone (XIV). Yield 87%, mp 177–179°C (methanol). ^{13}C NMR spectrum (DMSO-d_6), δ_C, ppm: 172.67 (C^2), 54.63 (C^3), 36.97 (C^4), 45.51 (C^5), 171.94 (COOH); 108.27, 111.44, 118.45, 119.01, 120.70, 126.69, 133.27, 136.02 (Ind), 11.88 (CH_3Ind). Found, %: C 65.00, 64.99; H 5.58, 5.57; N 10.99, 11.01. $C_{14}H_{14}N_2O_3$. Calculated, %: C 65.12; H 5.43; N 10.85.

4-(1-Methylindol-3-yl)-3-hydroxycarbonyl-2-pyrrolidone (XV). Yield 85%, mp 165–166°C (methanol).

Found, %: C 65.10, 65.09; H 5.40, 5.41; N 10.79, 10.80. $C_{14}H_{14}N_2O_3$. Calculated, %: C 65.12; H 5.43; N 10.85.

4-(1,2-Dimethylindol-3-yl)-3-hydroxycarbonyl-2-pyrrolidone (XVI). Yield 82%, mp 193–195°C (methanol). Found, %: C 66.09, 66.11; H 6.03, 6.03; N 10.48, 10.49. $C_{15}H_{16}N_2O_3$. Calculated, %: C 66.18; H 5.88; N 10.29.

4-(1-Benzylindol-3-yl)-3-hydroxycarbonyl-2-pyrrolidone (XVII). Yield 88%, mp 100–102°C (methanol). Found, %: C 71.70, 71.72; H 5.35, 5.36; N 8.34, 8.35. $C_{20}H_{18}N_2O_3$. Calculated, %: C 71.86; H 5.39; N 8.38.

4-(1-Benzyl-2-methylindol-3-yl)-3-hydroxycarbonyl-2-pyrrolidone (XVIII). Yield 83%, mp 168–170°C (methanol–acetone, 1 : 1). Found, %: C 72.50, 72.45; H 5.81, 5.80; N 8.13, 8.12. $C_{21}H_{20}N_2O_3$. Calculated, %: C 72.41; H 5.75; N 8.05.

4-(Indol-3-yl)-2-pyrrolidone (XIX). 4-(1-Indol-3-yl)-3-hydroxycarbonyl-2-pyrrolidone **XIII** (1.7 g, 0.007 mol) was heated on a glycerol bath (170–180°C) under reduced pressure (15–20 mmHg) until the evolution of carbon dioxide had ceased. The melt was cooled down and recrystallized. Yield 1.04 g (74%), mp 179–180°C (methanol) {mp 179–180°C (methanol) [6], 181–182°C (water) [10], 163°C (after column chromatography) [11], 170°C (diethyl ether) [13]}. Found, %: C 72.20, 72.23; H 6.14, 6.16; N 14.50, 14.55. $C_{12}H_{12}N_2O$. Calculated, %: C 71.98; H 6.04; N 13.99.

Compounds **XX**–**XXIV** were obtained similarly.

4-(2-Methylindol-3-yl)-2-pyrrolidone (XX). Yield 62%, mp 182–184°C (methanol). Found, %: C 72.87, 72.91; H 6.73, 6.70; N 12.94, 12.96. $C_{13}H_{14}N_2O$. Calculated, %: C 72.90; H 6.54; N 13.08.

4-(1-Methylindol-3-yl)-2-pyrrolidone (XXI). Yield 85%, mp 170–172°C (methanol). ^{13}C NMR spectrum (DMSO-d_6), δ_C, ppm: 176.81 (C^2), 37.81 (C^3), 32.82 (C^4), 48.55 (C^5); 110.30, 115.79, 119.05, 119.34, 121.83, 126.45, 127.04, 137.47 (Ind), 32.07 (CH_3Ind). Found, %: C 72.85, 72.86; H 6.49, 6.50; N 13.00, 13.02. $C_{13}H_{18}N_2O$. Calculated, %: C 72.90; H 6.54; N 13.08.

4-(1,2-Dimethylindol-3-yl)-2-pyrrolidone (XXII). Yield 79%, mp 193–195°C (methanol). Found, %: C 73.60, 73.61; H 7.07, 7.08; N 12.09, 12.10. $C_{14}H_{16}N_2O$. Calculated, %: C 73.68; H 7.02; N 12.28.

4-(1-Benzylindol-3-yl)-2-pyrrolidone (XXIII). Yield 83%, mp 165–167°C (methanol). Found, %: C 78.59, 78.60; H 6.18, 6.19; N 9.64, 9.64. $C_{19}H_{18}N_2O$. Calculated, %: C 78.62; H 6.21; N 9.66.

4-(1-Benzyl-2-methylindol-3-yl)-2-pyrrolidone (XXIV). Yield 72%, mp 88–90°C (diethyl ether). Found, %: C 79.02, 79.04; H 6.64, 6.62; N 9.31, 9.30. $C_{20}H_{20}N_2O$. Calculated, %: C 78.95; H 6.58; N 9.21.

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