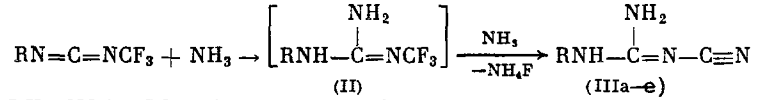
REACTION OF N-SUBSTITUTED N'-TRIFLUOROMETHYLCARBODIIMIDES WITH AMMONIA

I. V. Martynov, A. Yu. Aksinenko, O. V. Korenchenko,
A. F. Gontar', and V. B. Sokolov

UDC 542.91:547.491.6'
161:546.171.1

The information on the reactions of N-substituted N'-trifluoromethylcarbodiimides (I) with nucleophilic reagents is limited to the reaction with water and the formation of N-substituted N'-trifluoromethylureas and the cyclization of (I) in the presence of catalytic amounts of Et_3N [1]. In the present communication, we examined the reactivity of (I) relative to ammonia.

Carbodiimides (Ia)-(Ie) react exothermally with NH_3 to form the corresponding N-substituted N'-cyanoguanidines (IIIa)-(IIIe), apparently through highly reactive intermediate (II).



$$RN{=}C{=}NCF_3 + NH_3 \rightarrow \left[RNH{-}\overset{\displaystyle NH_2}{\overset{|}{C}}{=}NCF_3\right] \xrightarrow[-NH_4F]{NH_3} RNH{-}\overset{\displaystyle NH_2}{\overset{|}{C}}{=}N{-}C{\equiv}N$$

(II) (IIIa–e)

R = t-C_4H_9 (IIIa), C_6H_5 (IIIb), p-CH_3—C_6H_4 (IIIc), o-CH_3—C_6H_4 (IIId), o-Cl—C_6H_4 (IIIe).

Cyanoguanidines (IIIa)-(IIIe) are white crystalline compounds, whose structures were indicated by elemental analysis, IR and PMR spectroscopy. Cyanoguanidines (IIIa), (IIIb), and (IIId) were synthesized previously by the reaction of the hydrochloride salts of the corresponding amines with $NaN(CN)_2$ [2, 3].

EXPERIMENTAL

The IR spectra were taken on a Specord 75-IR spectrometer in vaseline mull using KBr plates and the PMR spectra were taken on a Bruker CXP-200 spectrometer in DMSO-d_6 solution.

2-tert-Butyl-2-cyanoguanidine (IIIa). Ammonia was passed into a solution of 8.3 g (0.05 mole) N-tert-butyl-N'-trifluoromethylcarbodiimide (Ia) in 50 ml CN_3CN at 25-30°C. At the end of the reaction, NH_4F was filtered off from the hot solution and washed with hot CH_3CN to give 7.3 g (88%) (IIIa), mp 189-190°C. Found: C 50.97; H 8.32; N 39.43%. Calculated for $C_6H_{12}N_4$: C 51.41; H 8.63; N 39.97%. IR spectrum (ν, cm^{-1}): 3420-3290 (NH_2), 2170 (C≡N), 1630 (C=N). PMR spectrum (δ, ppm): 1.38 s (9H), 6.44 s (2H), 6.64 s (1H).

1-Phenyl-2-cyanoguanidine (IIIb) was obtained by analogy to (IIIa) from 9.3 g (0.05 mole) (Ib). The product yield was 6.8 g (73%), mp 191-192°C. Found: C 59.31; H 5.04; N 34.50%. Calculated for $C_8H_8N_4$: C 59.99; H 5.03; N 34.98%. IR spectrum (ν, cm^{-1}): 3415, 3325, 3200 (NH_2, NH), 2175 (C≡N), 1635 (C=N). PMR spectrum (δ, ppm): 6.70 s (2H), 6.72-7.10 m (5H), 8.75 s (1H).

1-p-Tolyl-2-cyanoguanidine (IIIc) was obtained by analogy to (IIIa) from 10.1 g (0.05 mole) (Ic). The product yield was 5.0 g (50%) (IIIc), mp 208-210°C. Found: C 61.75; H 5.92; N 32.42%. Calculated for $C_9H_{10}N_4$: C 62.05; H 5.79; N 32.16%. IR spectrum (ν, cm^{-1}): 3420, 3330, 3200 (NH_2, NH), 2175 (C≡N), 1640 (C=N). PMR spectrum (δ, ppm): 2.35 s (3H), 7.05 s (2H), 6.25 d (4H), 9.08 s (1H).

1-o-Tolyl-2-cyanoguanidine (IIId) was obtained by analogy to (IIIa) from 8.7 g (0.043 mole) (Id). The product yield was 7.6 g (94%) (IIId), mp 120-122°C. Found: C 61.94; H 5.69; N 32.02%. Calculated for $C_9H_{10}N_4$: C 62.05; H 5.79; N 32.16%. IR spectrum (ν, cm^{-1}):

Institute of Physiologically Active Compounds, Academy of Sciences of the USSR, Chernogolovka. Translated from Izvestiya Akademii Nauk SSSR, Seriya Khimicheskaya, No. 10, pp. 2399-2400, October, 1988. Original article submitted January 19, 1987.

0568-5230/88/3710-2162$12.50

3425, 3325 (NH_2), 2175 ($C\equiv N$), 1630 ($C=N$). PMR spectrum (δ, ppm): 2.30 s (2H), 7.05 s (2H), 7.15-7.43 m (4H), 8.65 s (1H).

1-(2-Chlorophenyl)-2-cyanoguanidine (IIIe) was obtained by analogy to (IIIa) from 8.2 g (0.037 mole) (Ie). The yield of (IIIe) was 4.1 g (57%), mp 165-167°C. Found: C 49.98; H 3.69; N 29.03%. Calculated for $C_8H_7ClN_4$: C 49.37; H 3.63; N 28.79%. IR spectrum (ν, cm^{-1}): 3330, 3200 (NH), 2170 ($C\equiv N$), 1650 ($C=N$). PMR spectrum (δ, ppm): 7.30-7.70 m (6H), 7.75 s (1H).

CONCLUSIONS

N-substituted N'-trifluoromethylcarbodiimides react exothermally with ammonia to give N-substituted N'-cyanoguanidines.

LITERATURE CITED

1. W. F. Flowers, R. Franklin, and R. N. Haszeldine, J. Chem. Soc., Chem. Commun., 567 (1976).
2. F. H. S. Curd, J. A. Hendry, T. S. Kenny, and A. G. Murry, J. Chem. Soc., 1630 (1948).
3. S. M. Gadeakr, S. Nibi, and E. Cohen, J. Med. Chem., 11, 811 (1968).

EQUILIBRIUM CONSTANTS AND COMPLEXATION ENTHALPIES AND ENTROPIES OF LITHIUM, SODIUM, POTASSIUM, AMMONIUM, AND CALCIUM THIOCYANATES WITH BENZO-12-CROWN-4 IN ACETONITRILE

V. P. Solov'ev, N. N. Strakhova,
and O. A. Raevskii

UDC 541.121:536.722:536.75:
541.49:546.268.5-38:547.898

Macrocyclic polyethers (MCPE) tend to achieve cooperative bonding by means of the electron-donor oxygen atoms with various cations. This property is finding ever-increasing use in organic synthesis, polymer preparation, the extraction and separation of metal ions, and analytical chemistry [1]. The physiological activity of MCPE have been studied to a much lesser extent. We might expect that MCPE may have a significant effect on the functioning of living organisms due to their capacity to bind biometals. This has been confirmed in the finding of psychotropic activity of MCPE [2]. In this regard, undoubted interest lies in the stability of complexes of benzo-12-crown-4 (I) with various cations in solution. There is no information in the literature on this question.

In the present work, we obtained and discussed thermodynamic parameters for the complexation of Li, Na, K, NH_4, and Ca thiocyanates with benzo-12-crown-4 (I) in acetonitrile.

EXPERIMENTAL

The heats of reaction were measured in LKB-2107/112 and DAKI-1A calorimeters at 298.15 K. Solution calorimetry (mixing solutions and calorimetric titration) was used to determine the heats of reaction. The total reagent concentrations in the solution mixing method were in the range from 0.002 to 0.03 mole/liter for salts and from 0.001 to 0.05 mole/liter for the ligands. The concentrations of the titrated solution were in the range from 0.01 to 0.04 mole/liter, while the concentrations of the titrant were in the range from 0.2-0.5 mole/liter. The titration was continued until a two-fold excess of titrant was achieved above the concentration of the titrated compound. The calculations of the stoichiometry of complexes in equilibrium with the starting reagents, logarithms of the equilibrium constants, and the heats of complexation were carried out on a Nord-10 computer. These calculations and the statistical criteria for the selection of the model for the equilibria in solution in best

---

Institute of Physiologically Active Compounds, Academy of Sciences of the USSR, Chernogolovka. Translated from Izvestiya Akademii Nauk SSSR, Seriya Khimicheskaya, No. 10, pp. 2400-2402, October, 1988. Original article submitted June 22, 1987.

0568-5230/88/3710-2163$12.50