[CONTRIBUTION FROM THE KEDZIE CHEMICAL LABORATORY, MICHIGAN STATE COLLEGE]

THE STRUCTURE OF ALKYLATED 1-ALKYL-5-AMINOTETRAZOLES

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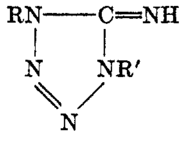
Received August 19, 1953

Recently a series of compounds prepared by the alkylation of 1-alkyl-5-aminotetrazoles was described (1). The products were formulated as 1-alkyl-5-alkylaminotetrazoles since certain of their chemical properties appeared to substantiate this structure. However, the wide divergence of their physical properties as compared with those of the 1-alkyl-5-aminotetrazoles caused some reservation as to the true structure of the dialkyl compounds.

Although the melting points of derivatives of certain pairs of dialkyl 5-aminotetrazoles were rather close, this had not been considered unusual since decomposition at the melting point was often involved. These melting points and decomposition points have now been redetermined together with those of mixtures of the compounds in question. For instance, the hydrochlorides of ethylated 1-methyl-5-aminotetrazole and methylated 1-ethyl-5-aminotetrazole show the same decomposition points. Similarly, the melting points of their phenylthiourea derivatives are the same. Mixture melting points were not depressed. The same situation maintains with derivatives of benzylated 1-ethyl-5-aminotetrazole and ethylated 1-benzyl-5-aminotetrazole and of phenylethylated 1-ethyl-5-aminotetrazole and ethylated 1-phenylethyl-5-aminotetrazole (Table I). These results indicate that the members of the respective pairs are identical.

Since benzylation of 1-ethyl-5-aminotetrazole and ethylation of 1-benzyl-5-aminotetrazole give the same benzyl ethyl 5-aminotetrazole, the two alkyl groups must occupy equivalent positions, a requirement satisfied by structure I (R is ethyl; R′ is benzyl) which represents a 1,4-dialkyl-5-imino-4,5-dihydrotetrazole. Identity of the two other pairs of alkylation products is also explained by I.



I

R or R′ = CH_3, C_2H_5, $C_6H_5CH_2$, $C_6H_5(CH_2)_2$

Structure I is further substantiated by the results of hydrogenolysis of several benzyl substituted aminotetrazoles by the general technique of Birkofer (2). After hydrogenolysis of the product formed by ethylation of 1-benzyl-5-aminotetrazole using palladium oxide catalyst, 1-ethyl-5-aminotetrazole was isolated in 87% yield indicating that the ethyl group had occupied the 4- (or 1-) position of the ring. Since the same product resulted on hydrogenolysis of the benzylation product of 1-ethyl-5-aminotetrazole, it is rather unlikely that alkylation was accompanied by rearrangement.

These results indicate that the compounds originally formulated as 1-alkyl-5-alkylaminotetrazoles (1) are actually 1,4-dialkyl-5-imino-4,5-dihydrotetrazoles.

TABLE I

MELTING POINTS OF 1,4-DIALKYL-5-IMINO-4,5-DIHYDROTETRAZOLES

5-IMINODIHYDROTETRAZOLE	M.P., °C. (Corrected)	
	Hydrochloride	Phenylthiourea
1-Methyl-4-ethyl	203 dec.	148–149
1-Ethyl-4-methyl	203 dec.	147–148
Mixture	203 dec.	148–149
1-Ethyl-4-benzyl	225 dec.	117–118
1-Benzyl-4-ethyl	224 dec.	117–118
Mixture	225 dec.	117–118
1-Ethyl-4-β-phenylethyl	—	80–81
1-β-phenylethyl-4-ethyl	—	80–81
Mixture	—	80–81

The formation of phenylthiourea derivatives by interaction of the bases with phenyl isothiocyanate may be attributed to the disubstituted cyclic guanidine structure apparent in I. The greatly enhanced basicity of the dialkyl compounds (1) may also be explained by the guanidine structure around the ring carbon and resonance stabilization of the guanidinium ion.

EXPERIMENTAL

1,4-Dialkyl-5-imino-4,5-dihydrotetrazoles were prepared by alkylation of suitable 1-alkyl-5-aminotetrazoles and derivatized as hydrochlorides and phenylthioureas as previously described (1). Melting points and decomposition points of appropriate pairs and their mixture were determined simultaneously in open capillary tubes to obviate possible differences due to the rate of heating. The results are given in Table I where the group introduced by alkylation is assigned the 4-position.

Hydrogenolysis of benzyl ethyl iminodihydrotetrazoles. A. A solution in 200 ml. of 85% ethanol of 12 g. (0.05 mole) of the hydrochloride of ethylated 1-benzyl-5-aminotetrazole [1-benzyl-5-ethylaminotetrazole (1)] was shaken with 0.5 g. of palladium oxide at a hydrogen pressure of 50 p.s.i. The theoretical amount of hydrogen was absorbed in 1.5 hours. The catalyst was filtered off, extracted thoroughly with hot ethanol, and the filtrate and washings were evaporated almost to dryness. The residue was taken up in 50 ml. of warm 99% isopropyl alcohol and the solution was dried over potassium carbonate. After evaporation of the solvent the residue was crystallized by dissolving in 20 ml. of warm absolute ethanol and adding dry ether to permanent turbidity. The product was 1-ethyl-5-aminotetrazole, yield 4.6 g. (78%), m.p. and mixture m.p. 147–148° (corrected) (1).

B. Hydrogenolysis of the hydrochloride of benzylated 1-ethyl-5-aminotetrazole [1-ethyl-5-benzylaminotetrazole (1)] under similar conditions gave 1-ethyl-5-aminotetrazole in equally good yield and with identical physical properties.

SUMMARY

Evidence is presented to establish that alkylation of 1-alkyl-5-aminotetrazoles leads to 1,4-dialkyl-5-imino-4,5-dihydrotetrazoles.

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REFERENCES

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(2) BIRKOFER, *Ber.*, **75**, 429 (1942).