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X-RAY AND ^{13}C NMR ANALYSES OF CONFORMERS OF 5-ARYLAMINO-1,2,4-TRIOXAN

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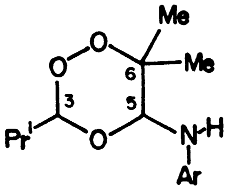
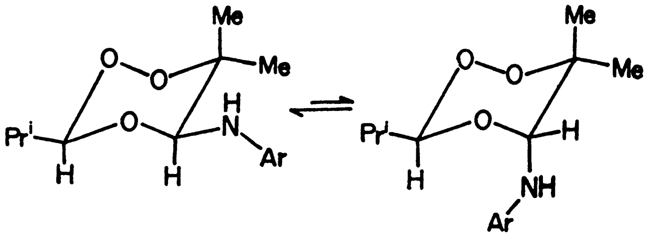
The X-ray analysis of 5-(*o*-chloroanilino)-3-isopropyl-6,6-dimethyl-1,2,4-trioxan showed to be the chair conformation of the trioxan ring with the axial *o*-chloroanilino and the equatorial isopropyl groups, which structure was also supported by ^{13}C NMR.

Previously, the authors reported the preparation of 5-arylamino-1,2,4-trioxans from arylamines and aldehydes in the presence of oxygen.$^{1)}$ Some of these trioxans, which were obtained from arylamines such as 1-naphthylamine, anthrylamines, and phenanthrylamines, showed the chemiluminescence by the treatment with base. The structures of these trioxans were deduced from the spectral data.$^{2)}$ Furthermore, 3-isopropyl-6,6-dimethyl-5-(1-naphthylamino)-1,2,4-trioxan (1) was found to be conformer E, which had the chair trioxan ring with the naphthylamino and isopropyl groups occupying equatorial positions (1E), based on the X-ray crystal-structure analysis.$^{3)}$ From the reaction mixture of *o*-chloroaniline



1 Ar = 1-naphthyl
2 Ar = *o*-chlorophenyl



conformer E conformer A

and isobutyraldehyde in the presence of oxygen, 5-(*o*-chloroanilino)-3-isopropyl-6,6-dimethyl-1,2,4-trioxan (2) was obtained by silica gel column chromatography as a liquid which seemed a mixture of two isomers by ^{13}C NMR spectrum. A minor component of the mixture slowly solidified by standing at 0 °C for a month. Recrystallization of the solid from hexane provided colorless prisms of 2 :[4)] yield 24.9%; mp 71-74 °C(decomp.). We now report the X-ray structure of this prisms of 2.

Crystal Data: $C_{14}H_{20}NO_3Cl$, M=285.77, monoclinic, space group $P2_1/c$, a=11.073(1), b=17.591(4), c=7.794(1) Å, β=94.48(1)°, U=1513.5 Å^3, Z=4, D_m=1.23, D_c=1.25 gcm^{-3}. Intensity data were collected on a Rigaku AFC-5 four-circle diffractometer using graphite-monochromated Mo-$K\alpha$ radiation (λ=0.71069 Å) up to 2θ=55°. The structure was solved by Patterson and Fourier methods and refined by full-matrix least-squares using 2471 reflections with $|F_o| > 3\sigma(F_o)$. All the hydrogen atoms were located on the difference Fourier maps and were included in the successive refinement with isotropic thermal parameters. Final refinement utilized anisotropic thermal parameters for all non-hydrogen atoms and converged to R=0.042 (R_w=0.049).

Perspective view of the molecule of 2 is given in Fig. 1. Trioxan 2 was found to be conformer A (2A), which had the chair trioxan with the *o*-chloroanilino

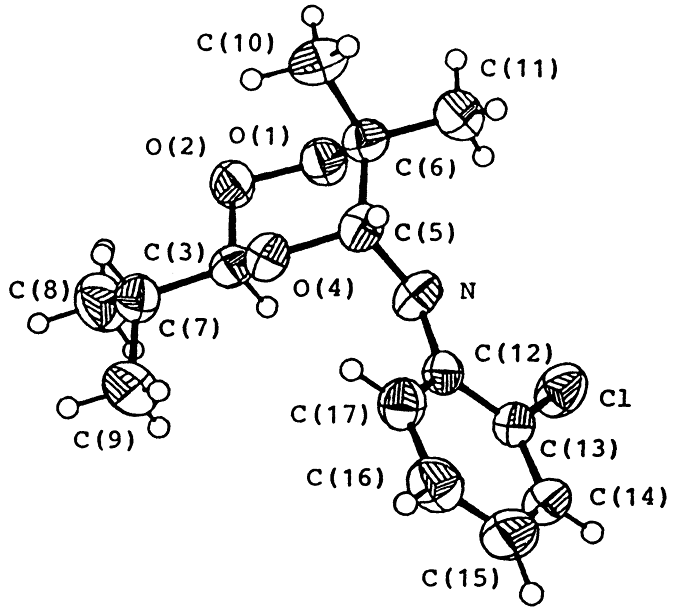


Fig. 1. The structure of 5-(*o*-chloroanilino)-3-isopropyl-6,6-dimethyl-1,2,4-trioxan 2. The molecule is drawn with thermal ellipsoids at 50% probability level for the non-hydrogen atoms and arbitrary spheres for hydrogens.

Table 1. ^{13}C chemical shifts (ppm from Me_4Si) for two conformers of trioxans 1 and 2 in $CDCl_3$ at 25 °C.

Compound	C-3	CH	CH_3, CH_3	C-5	eqCH$_3$	C-6	axCH$_3$
1E	107.1	31.0	16.9,16.7	86.7	22.0	80.0	17.6
1A a)	99.5 x_A b)=0.22	30.6	16.9,16.7	81.6	22.7	80.0	23.6
2E a)	107.1 x_E b)=0.74	31.0	16.8,16.7	85.8	21.9	79.7	17.5
2A	99.5	30.6	16.8,16.7	81.1	22.5	79.6	23.6

a) A conformer existed in the $CDCl_3$ solution.

b) Molar fraction of a conformer estimated from integration of the C-3 lines.

group occupying an axial position and isopropyl group an equatorial one. This result showed that the arylamino conformation of 2A was different from that of 1E.

From the ^{13}C NMR spectra of trioxans 1E and 2A, two conformers E and A could be clearly distinguished (Table 1). For example, the C-3 signal of 2A appeared at higher field than that of 1E. This may be ascribed to the fact that the γ-gauche-effect is more predominant than the γ-trans-effect for nitrogen.5) When the ^{13}C NMR spectrum of 1E which kept to stand for a long time in $CDCl_3$ solution was measured, new ^{13}C NMR signals appeared and were like to these of 2A. Similary, when 2A kept to stand for a long time in $CDCl_3$ solution, new ^{13}C NMR signals were observed and were like to these of 1E. According to newly appeared signals were regarded as these of 1A in the former and these of 2E in the latter, the above change of spectra could be explained on the basis from the anomerization at the C-5 of 1,2,4-trioxan ring. Since the change of ^{13}C NMR signal ratio of two conformers in both 1 and 2 ceased in ca. 24 h, it seemed that two conformers came to equilibrium in $CDCl_3$. Molar fractions of a conformer were calculated from integration of the C-3 lines at equilibrium (Table 1). The equilibrium constants K were obtained from molar fractions at 25 °C ($K_{E \rightarrow A}$=0.28 for 1 and $K_{A \rightarrow E}$=2.8 for 2). Further, the conformation free energy difference ΔG° from K values estimated ca. +0.7 kcal mol^{-1} for E→A exchange in 1 and -0.6 kcal mol^{-1} for A→E exchange in 2. In both 1 and 2, the predominant conformer in $CDCl_3$ was conformer E.

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4) Satisfactory elemental analysis data were obtained. IR (Nujol) 3430, 1310, 1245, 1140, and 1050 cm^{-1}; DI-MS (70 eV) m/e (rel intensity) 287, 285 (M^+, 4.2:13), 183, 181 (22:60), 158, 156 (33:100), 129, 127 (12:37), and 120 (70); ^1H NMR spectrum of conformer A $CDCl_3$ δ=0.84 (6H, d, J=6.5 Hz), 1.21 (3H, s), 1.67 (3H, s), 1.82 (1H, m), 4.80 (1H, d, J=9 Hz), 5.15 (1H, d, J=5 Hz), 5.37 (1H, d, J=9 Hz), and 6.4-7.3 (4H, m).
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