A NOVEL ASPECT OF THE 1,2-ALKYL MIGRATION REACTION WITH TRIALKYL 1-SUBSTITUTED INDOL-2-YLBORATES

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Abstract - Intramolecular 1,2-alkyl migration reaction of trialkyl(1-methoxyindol-2-yl)borates and trialkyl(1-methoxymethylindol-2-yl)borates gave rise to 2-alkylindoles and 2-alkyl-1-methylindoles, respectively.

Developing the synthetic advantages of indolylborate has been our current interest, and the investigations have been mainly done with trialkyl(1-methylindol-2-yl)borate due to its ready availability and sufficient reactivity.\(^1\) During the recent work aimed at substituting the rigid N-methyl group of the indolylborate for adequately removable N-protecting group, we found (i) a facile formation of 2-alkylindoles from trialkyl(1-methoxyindol-2-yl)borate (1a) and (ii) the formation of 2-alkyl-1-methylindoles from trialkyl(1-methoxymethylindol-2-yl)borate (1c) involving unexpected reduction of methoxymethyl group to methyl group, and these results are reported in this paper.

Treatment of 2-lithio-1-methoxyindole (derived from 1-methoxyindole and \(n\)-BuLi in THF at -20°C \(^2\)) with trialkylborane for 2 h generated borate (1a) \(\text{in situ}\), and subsequent addition of 10% aqueous NaOH and 30% aqueous H\(_2\)O\(_2\) under ice-cooling afforded 2-alkylindoles (2), which involves 1,2-alkyl migration and subsequent elimination of methoxy group as depicted in Scheme 1. On the other hand, borane (3)\(^3\) was isolated as air stable crystals in 20% yield from the reaction with 1-methylindolylborate (1b) under similar conditions.
On subjection of borate (1c) (generated in situ from 1-methoxymethylindole and n-BuLi in THF at -20°C for 20 min, followed by treatment with trialkylborane) to the reaction under the same conditions as above, 2-alkyl-1-methylindoles (4) were unexpectedly isolated (Scheme 2), wherein an intramolecular hydride transfer process may be envisioned. Tetraalkylborate has a high propensity to transfer intermolecularly one of the α-hydrogens in the presence of a reducible substrate such as allyl halide, ketone, or acyl halide. Therefore, the highly reducible nature of the methoxymethyl group in borate (1c), due to the equilibrium (1c ⇌ 1d), enhanced by increased electron density at nitrogen of the carbinolamine
moiety, as well as the intramolecular manner of the hydride transfer, is greatly responsible for the present reduction.

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\text{Scheme 2}
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REFERENCES AND NOTES


3. Analytical and spectral data for borane (3): Anal. Calcd for C_{23}H_{34}NB: C, 82.38; H, 10.22; N, 4.17. Found: C, 82.29; H, 10.31; N, 4.19. $^1$H Nmr (CDCl$_3$) δ: 0.30-0.60 (br, 2H), 0.70-2.10 (m, 23H), 2.80 (1H, d, J=16 Hz), 2.93 (s, 3H), 3.29 (d, 1H, J=16 Hz), 6.80-7.30 (m, 4H). $^{13}$C Nmr (CDCl$_3$) δ: 23.9, 26.2, 26.7, 27.1, 28.4, 31.4, 31.7, 32.5, 35.3, 39.0, 115.3, 124.5, 124.7, 126.4, 137.2, 149.2. Ms: m/z 334 and 335 (M$^+$).


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