Conversion of Amines into Imines by Swern Oxidation

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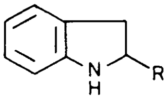
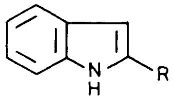
Indoline (**1**) and 2-methylindoline (**2**) have been converted into indole (**3**) and 2-methylindole (**4**), and dibenzylamine (**7**) and phenylbenzylamine (**8**) have been converted into the Schiff bases (**9**) and (**10**), by Swern oxidation; the methylthiomethyl amines (**5**), (**6**), (**11**), and (**12**) were the only other products formed.

The Swern oxidation of alcohols, which involves dimethyl sulphoxide (DMSO) and one of a range of electrophiles, is a widely used reaction. It works well with primary, secondary, allylic, benzylic, and also hindered alcohols, and compared with other oxidising agents it is relatively tolerant of additional functionality.[1] So far as we are aware, Swern reagents have not been used previously for the dehydrogenation of amines to imines. This is surprising in view of Swern's substantial early work on the conversion of amines into iminosulphuranes by activated DMSO reagents[2,3] and the dearth of good methods, particularly in non-polar solvents, for amine to imine conversion.[3] Of even greater interest would be a mild and simple general method for the conversion of indolines into indoles[4—7] because of the ready synthetic access to substituted indolines.[5b,6b] We have now found that Swern oxidation can be extended very successfully to accomplish this transformation.



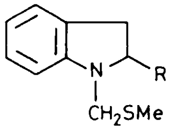
(1) R = H

(2) R = Me



(3) R = H

(4) R = Me



(5) R = H

(6) R = Me

$\mathrm{PhCH_2NHCH_2Ph}$

(7)

$\mathrm{PhCH_2NHPh}$

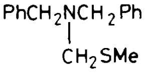
(8)

$\mathrm{PhCH{=}N{-}CH_2Ph}$

(9)

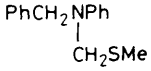
$\mathrm{PhCH{=}N{-}Ph}$

(10)



$\mathrm{PhCH_2}\underset{\mathrm{CH_2SMe}}{\mathrm{N}}\mathrm{CH_2Ph}$

(11)



$\mathrm{PhCH_2}\underset{\mathrm{CH_2SMe}}{\mathrm{N}}\mathrm{Ph}$

(12)

Thus, indoline (**1**) and 2-methylindoline (**2**) were converted into indole (**3**) and 2-methylindole (**4**) respectively, in yields approaching 90%. The only other products in each case, apart from about 1% of unchanged indoline, were the methylthiomethylamines (**5**) and (**6**). Reactions were carried out in 100 ml moisture-protected flasks, with magnetic stirring. Reagents were introduced dropwise, each over 5 min at −60 °C. Thus dimethyl sulphoxide (1.56 ml) in CH_2Cl_2 (3 ml) was added to oxalyl chloride (0.96 ml) in CH_2Cl_2 (12 ml). After stirring for 3 min, indoline (1.12 ml) in CH_2Cl_2 (3 ml) was added and the mixture stirred for 10 min. Triethylamine (7 ml) was added, and the mixture allowed to warm to 20 °C. Water (20 ml) was added, the aqueous layer washed with CH_2Cl_2 (20 ml), and the combined CH_2Cl_2 layers were washed with brine, dried ($MgSO_4$) and solvent removed *in vacuo*.

G.l.c. of the total crude product (2% SE 52 on GCQ at 115 °C) showed it to consist of indoline (**1**) [1.3%; *I* (Kováts Index) 1238], indole (**3**) (87.5%; *I* 1320), and the *N*-methylthiomethylindoline (**5**) [11.2%; *I* 1612; *m/z* 179 (M^+), 132 ($M^+ - SCH_3$)]. The 90 MHz ^1H n.m.r. spectrum was a superposition of the spectra of indole and the by-product (**5**) in the proportions indicated by g.l.c. Bulb–tube distillation afforded indole, b.p. 115 °C at 2 mmHg; m.p. 49—53 °C, identical (g.l.c., n.m.r., mass spec.) with authentic indole, and a residue consisting essentially of the by-product (**5**); ^1H n.m.r. δ 1.90 (3H, s, CH_3S), 3.02 (2H, t, CH_2CH_2N), 3.56 (2H, t, CH_2CH_2N), 3.58 (2H, s, N-CH_2S), and 6.6—7.4 (4H, m, C_6H_4).

2-Methylindoline (**2**) similarly afforded 2-methylindole (**4**), 88.3%, m.p. 58—60 °C, *I* 1403, and the oily by-product (**6**), 10.6%, *I* 1612, ^1H n.m.r. δ 1.90 (3H, s, CH_3S), 2.26 (3H, s, $NCHCH_3$), 3.56 (2H, s, CH_2S), which were separable by column chromatography over SiO_2.

Dibenzylamine (**7**) by the same procedure afforded the Schiff base (**9**), 63.4%, identical (i.r., n.m.r., mass spectra) with an authentic sample prepared from benzylamine and benzaldehyde, readily separated by bulb–tube distillation (210 °C at 0.25 mmHg) from the methylthiomethylamine (**11**), 36.6%, δ ($CDCl_3$) 2.14 (3H, s, CH_3S), 4.47 (4H, br.s, CH_2Ph), 5.28 (2H, s, CH_2S), 7.28 (10H, s, C_6H_5); *m/z* 257.1262 (M^+), 210.1280 ($M^+ - SCH_3$), 196.1124 ($M^+ - CH_2SCH_3$). Similarly, phenylbenzylamine (**8**) afforded the Schiff base (**10**), 52.5%, and the methylthiomethylamine (**12**), 47.5%, δ 1.92 (3H, s, CH_3S), 3.70 (2H, s, CH_2S) and 4.38 (2H, br.s, CH_2Ph).

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