Journal of Fluorine Chemistry, 19 (1981/82) 67–70

Received: March 13, 1981

THE REACTION OF INDOLIZINES AND ACETYLINDOLIZINES WITH TRIFLUOROMETHYLSULFENYL CHLORIDE

JULIAN MIREK

Institute of Chemistry, Jagiellonian University,
30-060 Cracow (Poland)

and ALOIS HAAS

Chair of Inorganic Chemistry II, Ruhr-University,
D-4630 Bochum (F.R.G.)

SUMMARY

Two trifluoromethylsulfenyl groups were introduced into the 1,3 positions of indolizines by the reaction of trifluoromethylsulfenyl chloride with indolizine and its 2-methyl, 2-phenyl, 2-methyl-3-acetyl and 2-phenyl-3acetyl derivatives

INTRODUCTION

The explicit recognition of the aromaticity of indolizines came from the forties [1]. Based on molecular orbital calculations, Dewar [2] arrived at the figure of 52 kcal/mole for the resonance energy of indolizine, although a somewhat higher figure of 62 kcal/mole, was also suggested [3]. Experimental evidence supports the theoretical predictions of the high reactivity of the 3 and the 1 positions of indolizine towards acetylation, nitration, nitrosation etc. Indolizines with a free 3 position react even with aromatic isocyanates and isothiocyanates giving amides [4].

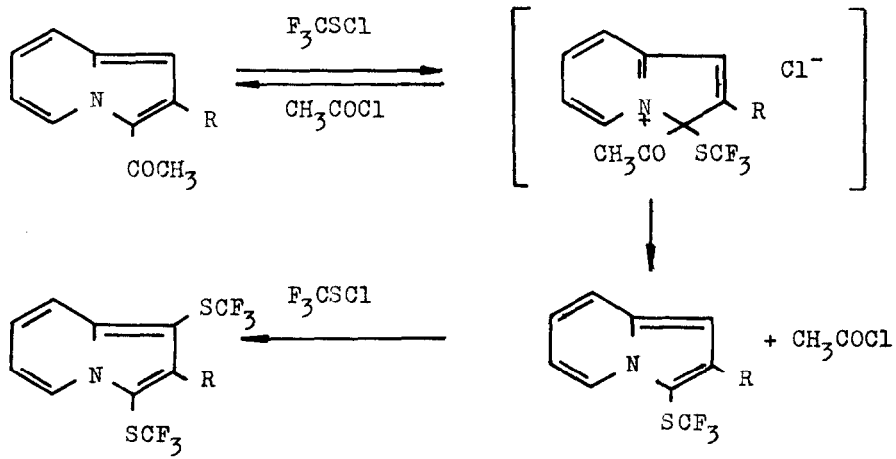
The reaction of trifluoromethylsulfenyl chloride with pyrrole, indole and other heteroaromatics [5], as well as azu-

lene derivatives [6], which are π-system isoelectronic with indolizine, gives rise to a number of products with mono, di, tri, and tetra CF_3S substitution.

We wish to report here the results of a study of the reaction between indolizines and trifluoromethylsulfenyl chloride using at mild conditions with a 2-3 molar excess of the sulfenyl chloride.

RESULTS AND DISCUSSION

The experiments show that at room temperature two trifluoromethylsulfenyl groups are introduced into the 1 and 3 positions of the indolizine system. The trifluoromethylsulfenyl chloride can replace the acetyl group from position 3 of indolizine (Id and Ie) probably through an intermediate as shown:



It is worth noticing that a 3-benzoyl substituent in 2-phenylindolizine is not removed by trifluoromethylsulfenyl chloride. For the benzoyl derivative a transition state with tetravalent carbon is probably unfavourable because of the greater electronegativity of benzoyl group in comparison with acetyl group.

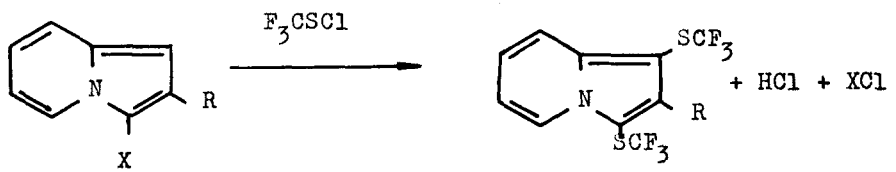
The oxygenation of (IIb) with hydroperoxide in acetic acid gave the N-oxide of 2-picolinic acid thus supporting the 1,3 disubstitution the of indolizine by the trifluoromethylsulfenyl substituent.

Two trifluoromethylsulfenyl groups are introduced into 2-methyl-3-benzylindolizine Ih , and probably one trifluoromethylsulfenyl group has entered the phenyl ring of the benzyl substituent.

EXPERIMENTAL

IR spectra were taken as KBr pellets on a Perkin-Elmer grating spectrometer 125. ^{19}F-NMR were taken as solutions in C_6F_6 and converted to CCl_3F standard. ^{1}H-NMR were taken on a Bruker 90 MHz spectrometer with TMS as standard. MS spectra were taken on a CH-5 Varian MAT spectrometer.

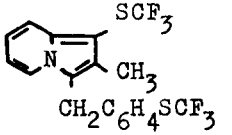
SYNTHESIS OF IIa, IIb, IIc, IIh. GENERAL PROCEDURE.



Ia, R = H, X = H
Ib, R = CH_3, X = H
Ic, R = C_6H_5, X = H
Id, R = CH_3, X = $COCH_3$
Ie, R = C_6H_5, X = $COCH_3$
If, R = C_6H_5, X = COC_6H_5 (no reaction)
Ig, R = C_6H_5, X = NO (no reaction)
Ih, R = CH_3, X = $CH_2C_6H_5$

IIa, R = H (quantitatively)
IIb, R= CH_3 (quantitatively)
IIc, R= C_6H_5 (quantitatively)
IIb, R = CH_3
IIc, R= C_6H_5 (quantitatively)

IIh,



In a 100 cm^3 glass tube reactor with a teflon stopper and a side tube, was placed indolizine (0.05 mole) and dry ether (30 cm^3). The reactor was degassed. Trifluoromethylsulfenyl chloride (about 0.15 mole) was introduced into the reactor from a vacuum line at liquid nitrogen temperature. The reaction mixture was left shaking at room temperature overnight. It was poured into 200 cm^3 cold water, left for complete evaporation of ether and the obtained precipitate filtered, washed with water and crystallised from ethanol. In the case of (Ig) the mixture was neutralised with sodium carbonate solution and filtered, washed with water and crystallised from ethanol.

IIa - M.p. 91-92° C; IR (KBr) 1200-1105 cm^{-1} (SCF_3). ^{19}F-NMR: δ = 44.83 and 45.69; $C_{10}H_5F_6NS_2$ (317.2) , M^+ = 317 m/e.
Analysis: Calcd.: C 37.85; H 1.59; N 4.42; S 20.21.
Found: C 37.62; H 1.51; N 4.40; S 20.20.

IIb - M.p. 72-73° C; IR(KBr) 1190-1100 cm^{-1} (SCF_3). ^{19}F-NMR: δ = 43.69 and 44.72; ^1H-NMR ($CDCl_3$): δ = 4.18 (CH_3).
$C_{11}H_7F_6NS_2$ (331.2) , M^+ = 331 m/e.
Analysis: Calcd.: C 39.88; H 2.13; N 4.23; S 19.45.
Found: C 39.80; H 2.22; N 4.42; S 19.44.

IIc - M.p. 115-116° C; IR (KBr) 1180-1100 cm^{-1} (SCF_3). ^{19}F-NMR: δ =43.69 and 44.70; $C_{16}H_9F_6NS_2$ (393.3), M^+ = 393 m/e.
Analysis: Calcd.: C 48.86; H 2.30; N 3.56; S 16.31.
Found: C 48.79; H 2.18; N 3.45; S 16.05.

IIh - M.p. 79.80° C; IR(KBr) 1190-1100 cm^{-1} (SCF_3). ^{19}F-NMR: δ = 42.70 and 45.38; ^1H-NMR($CDCl_3$) : δ = 4.31 (CH_3) , 4.41 (CH_2) . $C_{18}H_{13}F_6NS_2$ (421.3), M^+ = 421 m/e.
Analysis: Calcd.: C 51.30; H 3.14; N 3.32; S 15.22.
Found: C 51.50; H 3.10; S 14.95.

REFERENCES

1 E.I. Borrows, D.O. Holland, Chem. Rev., 42, 611 (1948); U. Tamake, M.Kiyoshi, Synthesis, 209-236, 1976.
2 M.J.S. Dewar, The Electronic Theory of Organic Chemistry. Oxford University Press, London 1949 p.p. 36,161,191
3 D.S. Matteson, University of Illinois, Organic Seminar Reports, (1961)
4 J. Mirek, Roczniki Chem., 40, 61 (1966); 41, 307 (1967)
5 A. Haas, U. Niemann, Advances in Inorganic Chemistry and Radiochemistry, Vol., 18, 181 (1976)
6 T.A. Holak, A. Haas, Chem. Scripta, 15, 67 (1980)