ONE STEP SYNTHESIS OF OPTICALLY ACTIVE AZIRIDINE WITH OPTICALLY ACTIVE o-METHOXYPHENYL PHENYL SULFILIMINE AND OLEFIN[1)]

Toshiaki Yoshimura, Takeshi Akasaka, Naomichi Furukawa, and Shigeru Oae*

Department of Chemistry, University of Tsukuba,
Sakura-mura, Niihari-gun, Ibaraki, Japan

Optically active 2-acylaziridines were synthesized in one step by treating optically active o-methoxyphenyl phenyl sulfilimine with α,β-unsaturated ketones in various solvents.

Recently, we found that free sulfilimines[2)] are relatively strong bases, e.g., pKa of diphenyl free sulfilimine is 8.5.[3)] Therefore these compounds should be good nucleophiles. Actually free sulfilimines can undergo the Michael-type addition with such electrophilic olefins as 1,2-dibenzoyl ethylene affording the corresponding aziridine and the enaminoketone in moderate yields.[4)] Meanwhile, we found a convenient and versatile procedure to prepare optically active o-methoxyphenyl phenyl N-p-tosylsulfilimine by treating o-methoxyphenyl phenyl sulfide with tert-butyl hypochlorite, ℓ-menthol and tosylamide anion in acetonitrile.[5)] A combination of these two processes, namely the Michael-type addition of an

optically active sulfilimine to the electrophilic olefins is considered to give the asymmetric induced aziridine derivatives.

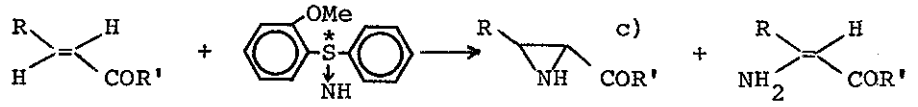
In this communication, we wish to report the one step synthesis of optically active aziridines by the Michael-type addition of imino group of (+)-(R)-o-methoxyphenyl phenyl free sulfilimine[6] to electrophilic olefins in various conditions.

Typically, (+)-(R)-o-methoxyphenyl phenyl sulfilimine (346 mg) was added to dibenzoylethylene (295 mg) in benzene at room temperature. After 1 hr., the reaction products were separated carefully by column chromatography avoiding fractionation of the products. The products thus obtained were identified by nmr and ir spectra, and the results are summarized in the Table.

The results clearly indicate that the imino-addition with the optically active sulfilimine to electrophilic olefins does afford the optically active aziridines.

In order to examine the solvent effect on the aziridine formation, a few reactions were carried out by changing the solvent. Inspection of the results shown in the Table reveals that in the case of the reaction of dibenzoylethylene, the product ratio of aziridine to enaminoketone is very sensitive to the solvent. In such a protic solvent as methanol, only a small amount of aziridine was obtained, but in DMSO solution, its amount is considerable. Meanwhile, the magnitude of asymmetric induction varies rather little by the nature of the solvent and temperature employed. The optical purities of the resulting aziridines have not been determined except in the case of (-)-trans-2-benzoyl-3-phenylaziridine (1). The optical rotation of (1) was increased

Table. Synthesis of Optically Active Aziridines



(I) (II)

Olefins R	R'	Optical Purity of the Sulfilimine	Conditions	Products and Yields(%) (I)	(II)	$[\alpha]_D$ d)	Optical Purity
PhCO	Ph	84.8%	C_6H_6,r.t.,1 hr	30 a)	68	-32.9°	-
PhCO	Ph	96.8%	CH_3OH,30°,1 hr	8 a)	90	-29°	-
PhCO	Ph	96.8%	DMSO,28°,1 hr	61 a)	37	-20.0°	-
Ph	Ph	84.8%	CH_2Cl_2,50°,48 hr	66 b)	0	-88.0°	28.7%
Ph	Ph	96.8%	CH_3OH,50°,12 hr	46 b)	0	-87.1°	28.4%
Ph	Ph	96.8%	CH_3OH,r.t.,6 days	53 b)	0	-93.3°	30.4%
Ph	Me	84.8%	C_6H_6,50°,24 hr	23 b)	0	-60.0°	-

a) Other product is o-methoxyphenyl phenyl sulfide(~100%).

b) Other product is o-methoxyphenyl phenyl sulfide, and the starting olefin was recovered.

c) All aziridines were found to have trans-form which is identified by methine-methine coupling constant of nmr, and other methods.[4]

d) All the specific rotations were measured in chloroform solution.

by several repeated recrystallizations from methanol, attaining finally $[\alpha]_D$=-306.8° (c=0.43) mp 123.5-4.5°C. If this optical rotation is considered as the maximum value, the optical purity of (1) ($[\alpha]_D$=-88.0°) can be calculated to be 28.7%.

In order to assign the configuration of (1), CD spectrum of (1) was taken and compared with that of (-)-trans-1-benzoyl-2-phenylcyclopropane (2) which was prepared by Johnson[7] and has a known configuration. Recently Cram et al.[8] determined the absolute configuration of (+)-(S)-N-phenyl-p-toluenesulfinamide by comparison of its ORD spectrum with that of the carbon analog, (+)-(R)-benzyl p-tolyl sulfoxide. The configuration of (2) was assigned by Johnson to (1R,2R).[9] Consequently, the CD curves of both the aziridine (1) obtained from this experiment and the cyclopropane (2) have similar structural features and signs of their Cotton effects ($[\theta]_{232}$=+23000, $[\theta]_{263}$=-29700, $[\theta]_{315}$=-13900 for (1) and $[\theta]_{260}$=-25600, $[\theta]_{312}$=-15700 for (2)). Thus the CD behaviors of (1) and (2) served as evidence to support that the absolute configurations of (1) and (2) are identical. Therefore the aziridine (1) should have (2R,3R)-configuration. The reaction is a quite simple and versatile method for the one step synthesis of an optically active aziridine ring.[10]

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10 There are two methods to obtain N-unsubstituted 2-acylaziridine, one[11,12] is the ammonolysis of α,β-dibromoketone (or α-bromo-α,β-unsaturated ketone), and the other is the two step synthesis[13] involving the Michael-addition of methoxyamine to α,β-unsaturated ketone followed by treatment of the adduct with base. The former reaction is rather complex and many by-products are formed. However, no preparation of optically active 2-acyl-aziridine is known in the literature.

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