Concise Syntheses of 4-(Arylcarbonylmethyl)-azetidin-2-ones and Related Systems

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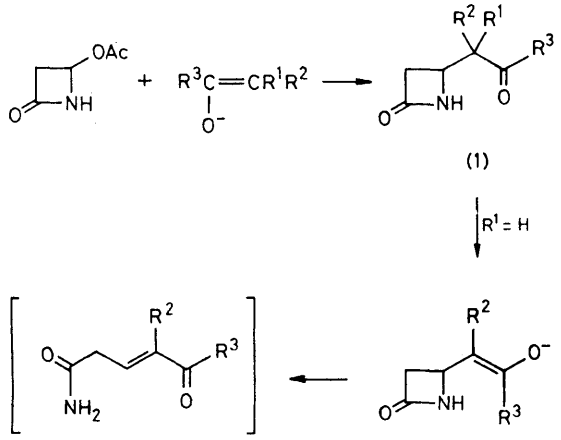
Summary On catalysis by trimethylsilyl trifluoromethanesulphonate, 4-acetoxy-1-trimethylsilylazetidin-2-one reacted with the enol silanes [$R^1CH{=}C(OSiMe_3)R^2$] to give the β-lactams [$\overbrace{CH_2CONHCHCH(R^1)COR^2}$] in excellent yields (71 to 95%).

THE displacement reactions of 4-acetoxyazetidin-2-one by heteroatomic nucleophiles are legion. In contrast, the replacement of the acetoxy-group by an enolate anion is fraught with difficulty. Generally the yields of the derived ketones, esters, *etc.* (**1**) are very poor[1,2] to modest[3] presumably on account of ring fragmentation[1] (Scheme 1).



Scheme 1

This fragmentation can be prevented using methyl 2-(diethoxyphosphoryl)phenylthioacetate or diethyl phenylthiomalonate[4] where $R^1 \neq H$, $R^2 \neq H$, but the derived β-lactams are synthetically unattractive.

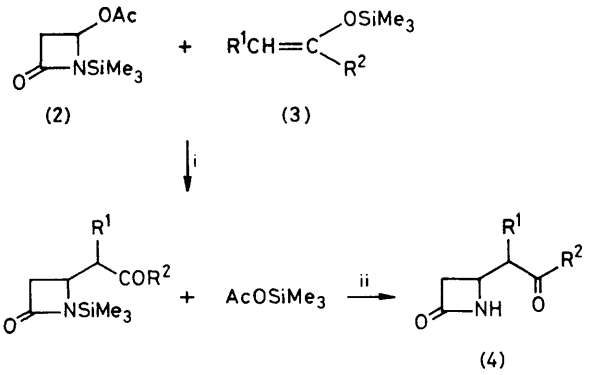
The transformation of 4-acetoxyazetidin-2-one directly, in high yield, into the ketones, esters, *etc.* (**1**; $R^1 = R^2 = H$) should be highly versatile in the preparation of thienamycin and analogues.[2,5] Herein we describe a concise method.

Table. Preparation of β-lactams (**4**).[a]

R^1	R^2	Yield/%
H	Ph	89
Me	Ph	71
H	4-MeC_6H_4	74
H	4-ClC_6H_4	81
Me	OEt	95
H	SPh	72

[a] All β-lactams were fully characterised by microanalysis and spectral data. β-Lactams (**4**, R^1 = Me) were obtained as mixtures of diastereoisomers.

4-Acetoxy-1-trimethylsilylazetidin-2-one (**2**) condensed cleanly with 1-phenyl-1-trimethylsilyloxyethene (**3**; R^1 = H, R^2 = Ph) at −78 to 20 °C in dichloromethane solution on catalysis (0·1 equiv.) by trimethylsilyl trifluoromethanesulphonate. Aqueous potassium fluoride work-up and recrystallisation from dichloromethane and light petroleum gave 4-benzoylmethylazetidin-2-one (**4**; R^1 = H, R^2 = Ph)[3] (89%) [m.p. 141—143 °C (lit.[3] 141—143 °C), ν_{max} (CH_2Cl_2) 3410, 1755, and 1680 cm^{-1}, δ($CDCl_3$) 2·71 (1H,dd, *J* 15, 3 Hz), 3·04—3·33 (2H,m), 3·49 (1H,dd, *J* 18, 4 Hz), 4·0—4·27 (1H,m), 6·4 br (1H,s), 7·37—7·71 (3H,m), and 7·92—8·06 (2H,m)] (Scheme 2). Further examples are tabulated. Clearly the diverse β-lactams (**4**) are henceforth readily available.



Scheme 2. i, $CF_3SO_3SiMe_3$, ii, KF–H_2O.

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[2] T. Kametani, T. Honda, A. Nakayama, and K. Fukumoto, *Heterocycles*, 1980, **14**, 1967.
[3] S. Oida, A. Yoshida, and E. Ohki, *Chem. Pharm. Bull.*, 1980, **28**, 3494.
[4] C. W. Greengrass and D. W. T. Hoople, *Tetrahedron Lett.*, 1981, 1161.
[5] *E.g.*, see R. W. Ratcliffe, T. N. Salzmann, and B. G. Christensen, *Tetrahedron Lett.*, 1980, 31.