SYNTHESIS OF β-LACTAMS USING THE PHOTOCHEMICAL REACTION OF 4-OXYGENATED 2-PYRIDONE DERIVATIVES

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4-(2-Hydroxyethyl)azetidin-2-ones and 4-alkoxycarbonylmethylazetidin-2-ones, important synthetic intermediates for carbapenems, have been synthesized from 5-oxygenated photopyridones (3-oxo-2-azabicyclo[2.2.0]hex-5-enes).

A solution of 4-acetoxy-2-pyridones (1, Z=COMe) in ether or ether-acetonitrile was irradiated at ≥ 300 nm to give the photopyridones (2, Z=COMe) in good yields. Catalytic reduction of 2 over Pd-C gave 3-oxo-2-azabicyclo[2.2.0]hexanes (3, Z=COMe). Treatment of 3 (Z=COMe) with K_2CO_3-$NaBH_4$ in MeOH, followed by acetylation with Ac_2O-pyridine afforded 4-(2-acetoxyethyl)azetidin-2-ones (6). On the other hand, compound 3 [R=H, Z=$SiMe_2$(t-Bu)], on treatment with acids, was transformed into 5-hydroxy-3-oxo-2-azabicyclo[2.2.0]hexane (3, R=Z=H), a stable synthetic equivalent of 4-(2-oxoethyl)azetidin-2-one (5, R=H). Compound 3 (R=Z=H) was also obtained from 3 (R=H, Z=CH_2Ph) by acidic hydrogenation over Pd-C. Compound 2 [R=H or Me, Z=$SiMe_2$(t-Bu)] was desilylated under acidic conditions to give 3,5-dioxo-2-azabicyclo[2.2.0]hexanes (4, R=H or Me) which was also prepared by treatment of 2 (Z=Me, CH_2Ph) with acids. Compound 4 reacted with various alcohols and hydrosulfides to give 4-alkoxy- and 4-alkylthio-carbonylmethylazetidin-2-ones (7, R'=OR and SR), respectively.