References

1. J. H. Choy, D. Y. Noh, J. C. Park, S. H. Chang, C. Delmas and P. Hagenmuller, *Mat. Res. Bull.*, **23**, 73 (1988).
2. J. H. Choy, S. H. Chang, D. Y. Noh and K. A. Son, *Bull. Korean Chem. Soc.*, **10**, 27 (1989).
3. J. H. Choy, D. Y. Noh, K. A. Son and D. Y. Seung, *Bull. Korean Chem. Soc.*, **10**, 210 (1989).
4. C. C. Torardi, J. C. Calabrese, K. Lázár and W. M. Reiff, *J. Solid State Chem.*, **51**, 376 (1984).
5. Landolt-Bornstein II/2, Springer Verlag, Berlin, 1966.
6. J. S. Griffith, *J. Inorg. Nucl. Chem.*, **2**, 1 (1956).
7. R. L. Martin and A. H. White, *Inorg. Chem.*, **6**, 712 (1967).
8. D. Mansuy, I. Morgenstern-Badarau, M. Lange and P. Gans, *Inorg. Chem.*, **21**, 1427 (1982).
9. M. E. Lines, *J. Phys. Chem. Solids*, **31**, 101 (1970).
10. Z. Jirak, R. Salmon, L. Fournes, F. Menil and P. Hagenmuller, *Inorg. Chem.*, **21**, 4218 (1982).

Cyclization of β-Amino Acids to β-Lactams by Using 1-Methanesulfonyloxy-6-trifluoromethylbenzotriazole

Young Haeng Lee*, Won Sik Choi†, and Dong-Seok Loh‡

Department of Chemistry, Won Kwang University, Iri 570-749

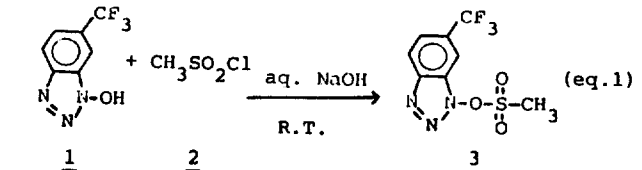
†Department of Genetic Science, Soon Chun Hyang University, Asan 330-62

‡Korea Advanced Institute of Science and Technology, Doping Control Center, Seoul 135-090

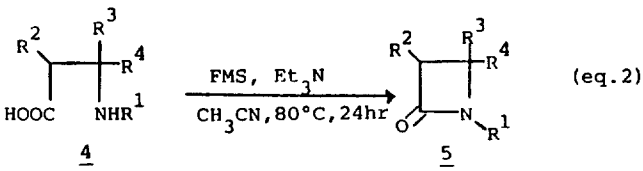
Received June 8, 1989

One of the popular synthetic methods for the β-lactam formation is based on the intramolecular cyclization of β-amino acids using coupling reagents[1]. Among various coupling reagents currently available, benzenesulfonyl chloride[2], triphenylphosphine/2,2'-dipyridyl disulfide[3], 2-chloro-1-methylpyridinium iodide[4], and benzotriazol-1-yloxytris(dimethylamino)phosphonium hexafluorophosphate[5] are the most effective and reliable.

In connection with our research program directed toward the development of new synthetic methodologies for the formation of β-lactam derivatives from β-amino acids, we have examined the β-lactam formation from β-amino acids using 1-methanesulfonyloxy-6-trifluoromethylbenzotriazole(FMS reagent, **3**). It has been reported that FMS reagent is the effective coupling reagent for the acylation of cephalosporins[6] and the esterification of dihydropyridine-3-carboxylic acid[7]. On the other hand, there are no reports on the application of FMS reagent for β-lactam formation from β-amino acids. In this paper, we wish to report a new method for the preparation of β-lactam derivatives (**4**) from β-amino acids (**5**) by using FMS reagent.



1 2 3



4 5

Table 1. Synthesis of β-Lactams from β-Amino Acids

Description	Isolated yield(%)
$R^1=CH_2Ph$, $R^2=H$, $R^3=R^4=CH_3$	94
$R^1=CH_2Ph$, $R^2=R^4=H$, $R^3=CH_3$	71
$R^1=CH_2Ph$, $R^2=CH_3$, $R^3=R^4=H$	50
$R^1=CH_2Ph$, $R^2=R^4=H$, $R^3=CO_2Ph$	58
$R^1=CH_2Ph$, $R^2=R^4=H$, $R^3=Et$	65
$R^1=CH_2Ph$, $R^2=R^4=H$, $R^3=Pr$	60
$R^1=c\text{-}C_6H_{11}$, $R^2=CH_3$, $R^3=R^4=H$	76
$R^1=c\text{-}C_6H_{11}$, $R^2=R^4=H$, $R^3=CH_3$	65
$R^1=R^2=H$, $R^3=R^4=CH_3$	22

FMS reagent was conveniently prepared by the reaction of 1-hydroxy-6-(trifluoromethyl)benzotriazole with methanesulfonyl chloride in aqueous sodium hydroxide solution at room temperature (eq. 1). The reagent **3** is a white crystalline solid melting at 98–100 °C and can be stored in a refrigerator for several weeks without any decomposition, and is generally used without further purification.

The representative experimental procedure is a follows (eq. 2); To a mixture of 3-benzylamino-3-methylbutanoic acid (310mg, 1.5mmol) and FMS reagent (510mg, 1.8mmol) in acetonitrile (150m*l*) was added triethylamine (360mg, 3.6mmol) at room temperature. After being stirred for 24 hr at 80 °C, the reaction mixture was concentrated under reduced pressure and the residue was passed through silica gel column using ether–chloroform (2:1) as an eluent to yield 1-benzyl-4,4-dimethyl-2-azetidinone (267mg, 94% yield) as an

oil.

We have briefly studied solvent effects using 3-benzylamino-2-methylpropanoic acid, 1.2 equivalent of FMS reagent and triethylamine at 80 °C for 24 hr. Among various solvents employed in this study, acetonitrile gave the best results, yielding 64% of 1-benzyl-3-methyl-2-azetidinone. N,N'-Dimethylformamide, dichloromethane, and tetrahydrofuran were much less effective, yielding the corresponding β-lactam in 25%, 22%, and 17% yield, respectively.

Some experimental results are summarized in Table 1. As can be realized, N-substituted β-amino acids were cyclized to the corresponding β-lactams in excellent yields but N-unsubstituted β-amino acids gave very poor results. Extention of the present study to include other coupling reagents for β-lactam formation is in progress.

Acknowledgement. This work was supported by the Basic Science Research Institute Program, Ministry of Education, 1988.

References

1. For recent reviews, see (a) K. Mukerjee and A. K. Singh, *Tetrahedron*, **34**, 1731 (1978); (b) K. Hirdi, *Yuki Gosei Kagaku Kyokai Shi*, **38**, 97 (1980); (c) R. Labia and C. Morin, *J. Antibiotics*, **37**, 1103 (1984).
2. Y. Watanabe and T. Mukaiyama, *Chem. Lett.*, 443 (1981).
3. S. Kobayashi, T. Limori, T. Izawa, and M. Ohno, *J. Am. Chem. Soc.*, **103**, 2406 (1981).
4. H. Huang, N. Iwasawa, and T. Mukaiyama, *Chem. Lett.*, 1465 (1984).
5. S. Kim and T. A. Lee, *Bull. Korean Chem. Soc.*, **9**, 189 (1988).
6. C. H. Lee, C. J. Moon, K. S. Kim, J. H. Kim, and D. W. Kim, *Bull. Korean Chem. Soc.*, **8**, 336 (1987).
7. Y. K. Shim, K. S. Kim, C. H. Lee, and W. J. Kim, *Bull. Korean Chem. Soc.*, **9**, 187 (1988).

Reductive Homocoupling of Benzal Bromides Catalyzed by Transition Metal Complex under Phase Transfer Catalysis

Sang Chul Shim*, Chil Hoon Doh, Woo Hyun Park, and Hyung Soo Lee†

Department of Industrial Chemistry, Kyungpook National University, Taegu 702-701

†Department of Chemical Education, Hyosung Women's University, Hayang 713-900

Received June 19, 1989

Recently, transition metals with a low oxidation state have been extensively used as reagents or catalysts for the reductive homocoupling reaction of benzal halides. For example, nickel[1], iron[2], cobalt[3], palladium[4], molybdenum[5], tungsten[6], copper[7], and vanadium[8] complexes have been employed for this purpose. Moreover, the reductive homocoupling reaction could occur under phase transfer catalysis in low selectivity[9].

In the course of investigation for the carbonylation of benzal bromides[10], $ArCHBr_2$, it was found that iron pentacarbonyl catalyzes the reductive homocoupling to give stilbenes with high selectivity under phase transfer catalysis[11]. To our knowledge, there are no such reactions reported. The reaction is described in Scheme 1 and the results are summarized in Table 1.

Table 1 shows that various transition metal complexes in the presence of 18-crown-6-ether as a phase transfer catalyst seem to be active catalysts for the reductive homocoupling of *p*-chlorobenzal bromide. In the cases of iron pentacarbonyl and diiron nonacarbonyl, the corresponding stilbenes were obtained in 78% and 74% yields in high selectivity, respectively. However, *p*-chlorophenylacetic acid was always produced less than 10% yield (runs 1 and 3). However, no product was obtained when molybdenum hexacarbonyl and dirhenium decacarbonyl were used (runs 4 and 6). Nevertheless, *trans*-4,4'-dichlorostilbene was obtained in 48% yield when 10M KOH[12]-molybdenum hexacarbonyl was used (run 5). In the case of dicobalt octacarbonyl, *trans*-4,4'-dichlorostilbene was obtained in 39% and carbonylated product, *p*-chlorophenylacetic acid, was obtained in 32% yields (run 7). When tetrakis(triphenylphosphine)-palladium(O) was used, *trans*-4,4'-dichlorostilbene was afforded in 60% yield (run 8). Other phase transfer agents such as tetrabutylammonium hydrogensulfate, benzyltriethylammonium chloride, and cetyltrimethylammonium chloride showed low selectivity toward stilbene formation. By these results, it was concluded that the combination of iron pentacarbonyl with 18-crown-6-ether was the most efficient catalytic system to the reductive homocoupling.

$$XC_6H_4CHBr_2 \xrightarrow[KOH\ (aq.)/PhH]{ML_n,\ 18C6,CO} (XC_6H_4CH=)_2$$

X = H, o-Cl, p-Cl, o-CH_3, and p-CH_3

ML_n = $Mo(CO)_6$, $Fe(CO)_5$, $Fe_2(CO)_9$, $Co_2(CO)_8$, and $Pd(PPh_3)_4$

Scheme 1

To confirm this observation, we attempted to investigate substituent effect of benzal bromides using iron pentacarbonyl in the presence of 18-crown-6-ether as a phase transfer catalyst. All of benzal bromides showed similar yields from 81% to 84%. This results indicated a small contribution of