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Communication

Triflic Anhydride Mediated Decarbonylative Arylation of Pyroglutamic Acid

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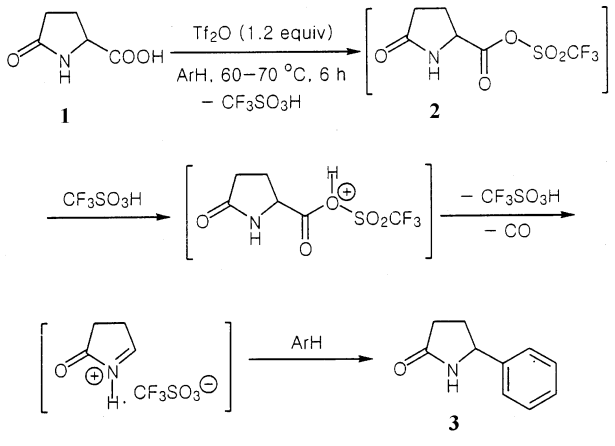
5-Aryl-2-pyrrolidinone derivatives are important due to their potential biological properties such as psychotropic activity.[1] During the course of our recent studies on the decarbonylative arylation reactions,[2] we examined the reaction of pyroglutamic acid (**1**) as a useful candidate for the formation of 5-aryl-2-pyrrolidinones **3**. However, we could not obtain the corresponding **3** from the reaction of **1** and benzene in the presence of sulfuric acid as in the cases of our previous reports. Literature survey showed that **3** could be prepared from the reaction of pyroglutamic acid and activated aromatics by using Eaton's reagent (7.5% P_2O_5 in methanesulfonic acid).[3] However, the method did not work well with benzene or chlorobenzene as aromatic nucleophiles. We think that the failure (the cases of H_2SO_4 in our trials and Eaton's reagent in Rigo's report[3]) might be due to insufficient activation of carboxylic acid of **1** to generate the corresponding acyl iminium ion.

Thus, we examined the reaction in the presence of trifluoromethanesulfonic anhydride in order to strongly activate the carboxylic acid functionality *in situ* as its mixed carboxylic sulfonic anhydride.[4] Pyroglutamic acid (**1**) and triflic anhydride might generate mixed carboxylic sulfonic anhydride **2**,[4] which loses trifluoromethanesulfonic acid and carbon monoxide easily to generate cycilc acyl iminium salt. This reactive acyl iminium salt reacts with benzene yielding 5-phenyl-2-pyrrolidinone (**3**) in 56% isolated yield as shown in Scheme 1.

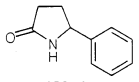
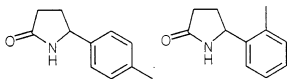
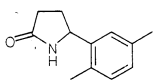
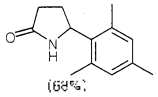
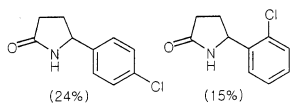
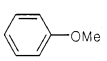
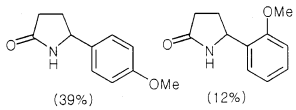


1 **2** **3**

Scheme 1

Representative examples are listed in Table 1. As shown in Table 1, the corresponding 5-aryl-2-pyrrolidinone deriva-

Table 1. Synthesis of 5-aryl-2-pyrrolidinone derivatives[5]

Entry	Arene	Product, 3 (% yield)
1		 (56%)
2		 (65%, para : ortho = 75:25)
3		 (78%)
4		 (68%)
5		 (24%) (15%)
6		 (39%) (12%)

tives were obtained in good to moderate yields from various substrates including benzene, chlorobenzene, and anisole. The use of trifluoromethanesulfonic acid, $POCl_3$, or trifluoroacetic anhydride instead of triflic anhydride did not give detectable amount of **3**. Further studies on the triflic anhydride mediated decarbonylative arylation reaction toward other systems are undergoing including intramolecular type reaction and the formation of 5-aroyl-2-pyrrolidinone derivatives.

References

1. (a) Bocchi, V.; Gardini, G. P.; Pinza, M. *Farmaco, Ed. Sci.* **1971**, *26*, 429. (b) *Ger. Offen.* 2,136,571 (1972) (*Chem. Abstr.* **1972**, *76*, 113055v).
2. (a) Seong, M. R.; Lee, H. J.; Kim, J. N. *Tetrahedron Lett.* **1998**, *39*, 6219. (b) Seong, M. R.; Song, H. N.; Kim, J. N. *Tetrahedron Lett.* **1998**, *39*, 7101. (c) Seong, M. R.; Kim, T. Y.; Lee, H. J.; Kim, J. N. *Bull. Korean Chem. Soc.* **1999**, *20*, 609.
3. Rigo, B.; Fasseur, D.; Cherepy, N.; Couturier, D. *Tetrahedron Lett.* **1989**, *30*, 7057.
4. (a) Effenberger, F.; Sohn, E.; Epple, G. *Chem. Ber.* **1983**, *116*, 1195. (b) Keumi, T.; Yoshimura, K.; Shimada, M.; Kitajima, H. *Bull. Chem. Soc. Jpn.* **1988**, *61*, 455. (c) Yamato, T.; Hideshima, C.; Prakash, G. K. S.; Olah, G. A. *J. Org. Chem.* **1991**, *56*, 3955. (d) Hulin, B.; Koreeda, M. *J. Org. Chem.* **1984**, *49*, 207.
5. As a typical reaction for the formation of 5-phenyl-2-pyrrolidinone (entry 1): To a stirred suspension of pyroglutamic acid (258 mg, 2 mmol) in dry benzene (10 mL) was added triflic anhydride (677 mg, 2.4 mmol), and stirred at 60-70 °C during 6 h. The reaction mixture was poured into cold water, extracted with ethyl acetate (100 mL × 2), and the combined organic layers were evaporated to dryness. Flash column chromatography (SiO_2, ether/dichloromethane = 1 : 1) afforded the desired product, 180 mg (56%) as a white solid: mp 106-107 °C (lit,[3] 107 °C); ^{1}H NMR ($CDCl_3$) δ 1.90-2.03 (m, 1H), 2.34-2.63 (m, 3H), 4.76 (t, J = 6.9 Hz, 1H), 6.64 (br s, 1H), 7.26-7.40 (m, 5H); ^{13}C NMR ($CDCl_3$) δ 30.29, 31.14, 58.02, 125.49, 127.67, 128.74, 142.51, 178.74; MS (70 eV) *m z* (rel intensity) 41 (56), 51 (70), 55 (57), 77 (69), 84 (64), 104 (69), 160 (73), 161 (M^+, 100).