Asian Journal of Chemistry Vol. 17, No. 4 (2005), 2371–2374

Microwave Induced One-pot Stereoselective Synthesis of Alkyl Z-2-[2-amino-4-oxo-1,3-selenazol-5(4*H*)-yliden)acetates in Solvent-less Conditions

ALI RAMAZANI*†, EBRAHIM AHMADI†, BIJAN GANJEIE
ALI REZA KAZEMIZADEH and ALI MORSALI‡
Chemistry Department, Zanjan Islamic Azad University,
P.O. Box: 49195-467, Zanjan, Iran
E-mail: a-ramazani@mail.znu.ac.ir; aliramazani@yahoo.com

Selenourea reacts with dialkyl acetylenedicarboxylates in solvent-less conditions to form 1 : 1 adducts, which undergo a cyclization reaction to produce alkyl Z-2-(2-amino-4-oxo-1,3-selenazol- 5(4*H*)-yliden)acetates under microwave irradiation and also under thermal conditions in solvent-less system in fairly good yields. Stereochemistry of the ethyl Z-2-(2-amino-4-oxo-1,3-selenazol-5(4*H*)-yliden)acetate was established with using of X-ray single crystal structure analysis. The reaction is completely stereoselective.

Key Words: Solvent-less system, Selenourea, Microwave irradiation, Acetylenic ester, Michael addition, Stereoselectivity, X-ray single crystal structure analysis, 1,3-Selenazoles.

INTRODUCTION

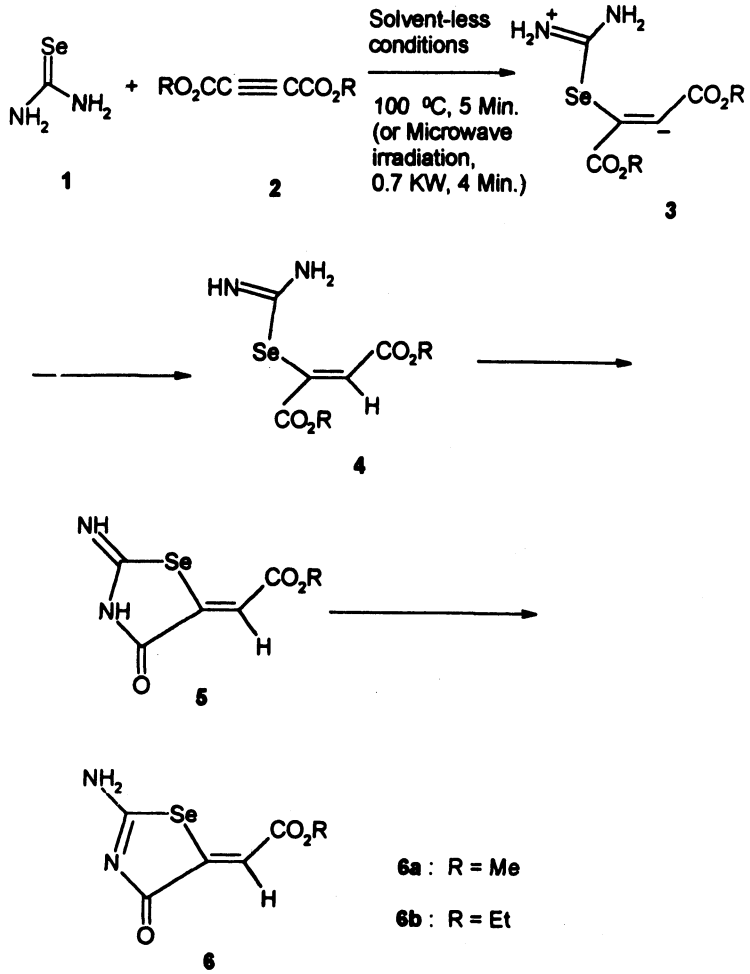
Though sulfur-containing heterocyclic compound syntheses have been extensively studied, syntheses of selenium analogues have not been appreciably investigated[1–4]. Recently, however, reports of selenium-containing heterocyclic compound synthesis have gradually increased not only because of their interesting reactivities but also because of their pharmaceutical applications. For example, 1,3-selenazines showed significant antibacterial activity against both gram-negative and Gram-positive bacteria and potential antitumour effects against several kinds of human cancer cell lines. Selenazofurin demonstrated significant antitumour properties in animals and broad spectrum antiviral activity in cell culture experiments[3–5]. Selenoureas and selenoamides have been used as the precursors for most of the syntheses of 1,3-selenazines and 1,3-selenazoles[3]. Dialkyl acetylenedicarboxylates (2) are reactive systems, which take part in many

†Chemistry Department, Zanjan University, P.O. Box 45195-313, Zanjan, Iran.
‡Chemistry Department, Tarbiat Modarres University, P.O. Box 14155-4838, Tehran, Iran.

chemical reactions[6]. These results prompted us to examine the one-pot reaction of dialkyl acetylenedicarboxylates (**2**) with selenourea (**1**) in solvent-less conditions under microwave irradiation and also under thermal conditions (**Scheme-1**).

RESULTS AND DISCUSSION

The compound (**6**) may result from initial Michael addition reaction of selenourea **1** to the acetylenic ester **2** and concomitant intramolecular proton transfer of the 1 : 1 adduct **3**, followed by attack of the imine nitrogen on the carbonyl group of the ester to form intermediate **5** (**Scheme-1**). Intramolecular proton transfer of the intermediate **5** leads to the formation of the alkyl *Z*-2-(2-amino-4-oxo-1,3-selenazol-5(4*H*)-yliden)acetates (**6**), in fairly good



Scheme-1

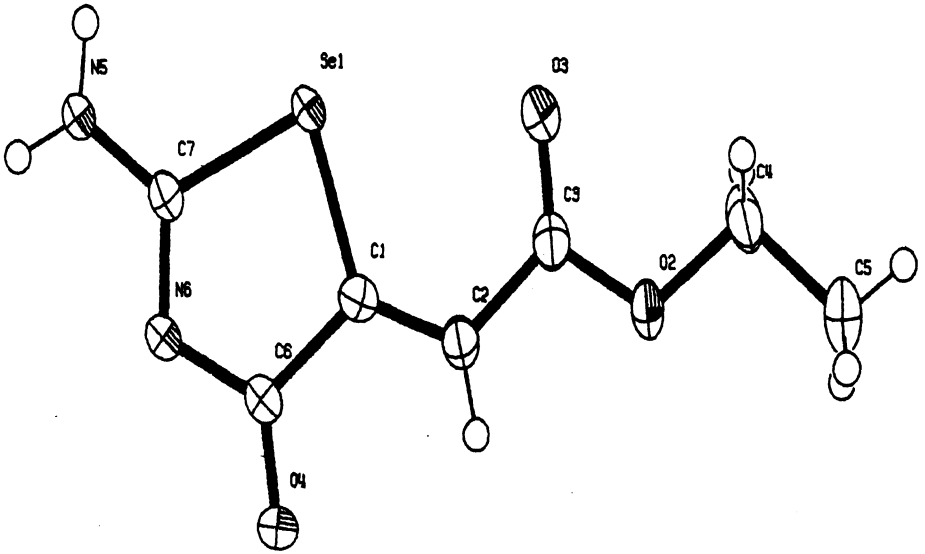


Fig. 1. Molecular structure of **6b**.

yields. TLC indicated that the reaction was completed in solvent-less conditions at 100°C after 5 min. We have also found that the reaction was completed in solvent-less conditions under microwave irradiation (0.7 kW) after 4 min. The reaction proceeds smoothly and cleanly under the reaction conditions. The structures of **6a and b** were deduced from their IR, ^{1}H NMR and ^{13}C NMR spectra and also *via* X-ray single crystal (for **6b**) structure determination (Fig. 1.). The reaction is completely stereoselective.

EXPERIMENTAL

Commercial oven butane M245 was used for microwave irradiation. Melting points were measured on an Electrothermal 9100 apparatus and are uncorrected. IR spectra were recorded on a Shimadzu IR-460 spectrometer. ^{1}H and ^{13}C NMR spectra were measured with a Bruker DRX-500 Avance spectrometer at 500 and 125 MHz respectively.

General procedure for the preparation of alkyl Z-2-(2-amino-4-oxo-1,3-selenazol-5(4*H*)-yliden)acetates (6a, b): Selenourea **1** (1 mmol) and acetylenic ester **2** (1 mmol) were ground at 100°C in 5 min (or under microwave irradiation, 0.7 kW, 4 min.). The mixture was then washed with cold acetone (3 mL) and white powders of **6** were collected by filtration.

Selected data for methyl Z-2-(2-amino-4-oxo-1,3-selenazol-5(4*H*)-yliden)acetate (6a): White crystals, m.p. 232.8–233.2°C, yield 58.2%. IR (KBr) (ν_{max}, cm^{-1}): 3217, 3054, 2970, 2823, 1689, 1666, 1496, 1365, 1288, 1180. ^{1}H NMR (DMSO-d_6) δ(H): 3.77 (3H, s, CH_3); 6.95 (1H, s, =CH); 9.4 (1H, br s,

NH); 9.7 (1H, br s, NH).^{13}C NMR (DMSO-d_6) : 52.65 (CH_3), 118.11 (=CH); 152.44 (=CSe); 167.07 (C-NH_2); 174.69 and 181.00 (2C=O).

Selected data for ethyl Z-2-(2-amino-4-oxo-1,3-selenazol-5(4*H*)-yliden)-acetate (6b): White crystals, m.p. 214.4–216.9°C, yield 56.5%. IR (KBr) (ν_{max}, cm^{-1}): 3209; 3055; 2985; 2823; 2970; 1705; 1674; 1501; 1280; 1195. ^{1}H NMR (DMSO-d_6) δ(H): 1.25 (3H, t,$^3J_{HH}$ = 7.1 Hz, CH_3); 4.23 (2H, q, $^3J_{HH}$ = 7.1 Hz, OCH_2); 6.92 (1H, s, =CH); 9.27 (1H, br s, NH); 9.76 (1H, br s, NH).^{13}C NMR (DMSO-d_6) δ(C): 13.99 (CH_3), 61.49 (OCH_2), 118.41 (=CH); 152.21 (=CSe); 166.49 (C-NH_2); 174.71 and 181.01 (2C=O).

ACKNOWLEDGEMENTS

This work was supported by the Zanjan Islamic Azad University Research Council *via* research project number ZIAURC83.1307. We thank also Dr. Mehdi Rahnema (Rector of Zanjan Islamic Azad University Research Council) for helpful discussions and financial support.

REFERENCES

1. O.A. Attanasi, P. Filippone, F.R. Perrulli and S. Santeusanio, *Eur. J. Org. Chem.*, 2323 (2002) and references cited therein.
2. M. Koketsu, Y. Takenaka and H. Ishihara, *Synthesis*, 731 (2001) and references cited therein.
3. M. Koketsu and H. Ishihara, *Curr. Org. Chem.*, **7**, 175 (2003).
4. M. Koketsu, S.Y. Choi, H. Ishihara, B.O. Lim, H. Kim and S.Y. Kim, *Chem. Pharm. Bull. (Tokyo)*, **50**, 1594 (2002).
5. W. Wu, K. Murakami, M. Koketsu, Y. Yamada and I. Saiki, *Anticancer Res.*, **19**, 5375 (1999).
6. A. Ramazani, L. Yousefi, E. Ahmadi and A. Souldozi, *Phosphorus, Sulfur and Silicon*, **179**, 1459 (2004) and references cited therein.

(*Received*: 23 October 2004; *Accepted*: 15 June 2005) AJC-4261