

NOTE**One-Pot Synthesis of Dialkyl 2-[(2,5-Dioxo-1-pyrrolidinyl)-oxy]-2-butenedioates from Acetylenic Esters and *n*-Hydroxysuccinimide**

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A one-pot synthesis of electron-poor O-vinyl pyrrolidine in fairly high yields by the reaction of N-hydroxysuccinimide and dialkyl acetylenedicarboxylates in water-acetone media is reported. The structures of these compounds were confirmed by IR, ¹H and ¹³C NMR spectroscopy. The NMR spectra indicated that *E*- and *Z*-isomers of the products are formed.

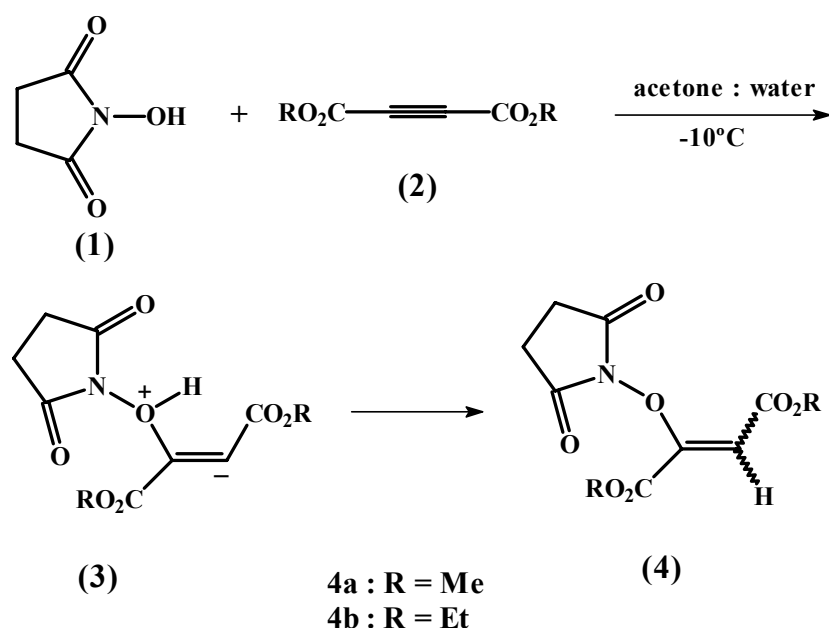
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Development of simple synthetic routes for widely-used organic compounds from readily available reagents is one of the major tasks in organic chemistry¹. Pyrrolidines and their derivatives are very useful as starting materials to produce pharmaceutically and industrially important compounds²⁻⁴. Some of these compounds are useful as potential antitumor agents^{2,3}. Some of the pyrrolidine derivatives acts as corrosion inhibitors for steel⁴. Owing to these characteristics and our interest in the synthesis of heterocycles^{5,6}, we report a simple, one-pot synthesis of dialkyl 2-[(2,5-dioxo-1-pyrrolidinyl)oxy]-2-butenedioates (**4**) from the reaction of N-hydroxysuccinimide (**1**), dialkyl acetylenedicarboxylates (**2**) in fairly high yields (**Scheme-I**).

Melting points were measured on an Electrothermal 9100 apparatus and are uncorrected. IR spectra were recorded on a Shimadzu IR-460 spectrometer. ¹H and ¹³C spectra were measured with a Bruker DRX-500 Avance spectrometer at 250.0 and 62.5 MHz, respectively.

General procedure for the preparation of dialkyl 2-[(2,5-dioxo-1-pyrrolidinyl)oxy]-2-butenedioates (4a-b): To a magnetically stirred solution of N-hydroxysuccinimide (**1**) (0.115 g, 1 mmol) in acetone-water (5:1) (5 mL) was added dropwise a mixture of (**2**) (1 mmol) in acetone

(2 mL) at -10°C over 15 min. The mixture was allowed to warm up to room temperature and stirred for 24 h. The crystals of (**4a**) is formed after gradually vapourization of solvent and compound (**4b**) is obtained as a pure liquid after removing of the solvent under reduced pressure as a single spot.



Scheme-I

Selected data for dimethyl 2-[(2,5-dioxo-1-pyrrolidinyl)oxy]-2-butenedioates (4a**):** White crystals, m.p. 84-86 , yield 77.1 %. IR (KBr, ν_{max} , cm^{-1}): 3192, 2946, 1746, 1662. ^1H NMR (CDCl_3), (*E*) isomer 69 % and (*Z*) isomer 31 %, δ_{H} : 2.71-2.85 (4H, 2m, CH_2CH_2); 3.71, 3.73, 3.83 and 3.90 (6H, 4s, 4 OCH_3); 5.54 and 6.35 (1H, 2s, =CH). ^{13}C NMR (CDCl_3) δ_{C} : 25.34 and 25.55 (2 CH_2CH_2); 52.30 and 53.50 (2 OCH_3); 100.29 and 109.13 (2 =CH); 149.66 and 156.97 (2 =C-O); 160.29 and 163.00 (2CO of esters); 168.44 and 169.08 (2C=O imide).

Selected data for diethyl 2-[(2,5-dioxo-1-pyrrolidinyl)oxy]-2-butenedioates (4b**):** Yield 75.6 %. IR (KBr, ν_{max} , cm^{-1}): 3123, 2930, 1600. ^1H NMR (CDCl_3), (*E*) isomer 62 % and (*Z*) isomer 38 %, δ_{H} : 1.20-1.36 (6H, m, 2 CH_3); 2.74-2.83 (4H, 2m, CH_2CH_2); 4.10-4.38 (4H, m, 2 OCH_2); 5.50 and 6.33 (1H, 2s, =CH).

The electron-poor O-vinyl pyrrolidine (**4**) may result from initial Michael addition reaction of N-hydroxysuccinimide (**1**) to the acetylenic ester (**2**) and concomitant intramolecular proton transfer of the 1:1 adduct (**3**) (**Scheme-I**). TLC indicated that the reaction was completed in acetone-water (5:1) at room temperature after 24 h. The use of water in organic synthesis is very important from view of green chemistry. The reaction proceed smoothly and cleanly under the reaction conditions. The structures of (**4a-b**) were deduced from their IR, ¹H NMR and ¹³C NMR spectroscopy. The NMR spectra indicated that solutions of compounds (**4a-b**) (CDCl₃ as solvent) contain two stereoisomers (**4a**: *E*, 69 %; *Z*, 31 % and **4b**: *E*, 62 %; *Z*, 38 %). The relative percentages of stereoisomers in CDCl₃ for each electron-poor O-vinyl pyrrolidine (**4**) were determined from the ¹H NMR spectra.

In summary, a new, efficient and environment-friendly, one-step method has been developed for the preparation of compounds (**4a-b**) in acetone-water at room temperature in fairly high yield. Other aspects of this process are under investigation (**Scheme-I**).

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REFERENCES

1. P. Laszlo, *Organic Reactions: Simplicity and Logic*, Wiley, New York (1995).
2. L. Ya-Lin and X. Wen-Fang, *Bioorg. Med. Chem.*, **12**, 5171 (2004).
3. L. Xun, L. Ya-Lin and X. Wen-Fang, *Bioorg. Med. Chem.*, **14**, 1287 (2006).
4. M. Bouklah, A. Quassini, B. Hammouti and A. El-Idrissi, *Appl. Surf. Sci.*, **252**, 2178 (2006).
5. A. Ramazani, A.R. Kazemizadeh, B. Ganjeie and E. Ahmadi, *Phosphorus, Sulfur, Silicon Rel. Elem.*, **180**, 2569 (2005).
6. A. Ramazani, F. Marandi and A.R. Kazemizadeh, *Phosphorus, Sulfur, Silicon Rel. Elem.*, **180**, 1541 (2005).