LITERATURE CITED

1. W. A. Sheppard and C. M. Sharts, Organic Fluorine Chemistry, W. A. Benjamin, New York (1969).
2. K. V. Scherer, J. T. Ono, K. Yamanouchi, et al., J. Am. Chem. Soc., 107, 718 (1985).
3. B. L. Tumanskii, S. P. Solodovnikov, N. N. Bubnov, et al., Izv. Akad. Nauk SSSR, Ser. Khim., No. 8, 1926 (1989).
4. B. L. Tumanskii, T. V. Timofeeva, A. A. Kadyrov, et al., Dokl. Akad. Nauk SSSR, No. 5, 1152 (1990).
5. T. Kawamura, D. J. Edge, and J. K. Kochi, J. Am. Chem. Soc., 94, No. 5, 1752 (1972).
6. P. J. Krusic and K. V. Scherer, Jr., J. Fluorine Chem., 35, No. 1, 44 (1987).
7. J. K. Kochi and P. J. Krusic, Essays in Free Radical Chemistry, Chem. Soc., Special Publ., No. 24, 147 (1970).
8. B. Smart, P. J. Krusik, P. Meakin, and R. C. Bingham, J. Am. Chem. Soc., 96, No. 23, 7382 (1974).
9. B. L. Tumanskii, N. N. Bubnov, V. R. Polishchuk, and S. P. Solodovnikov, Izv. Akad. Nauk SSSR, Ser. Khim., No. 10, 2222 (1981).
10. E. G. Ter-Gabriélyan, N. P. Gambaryan, E. P. Lur'e, and I. L. Knunyants, Dokl. Akad. Nauk SSSR, 254, No. 4, 898 (1980).

SYNTHESIS OF DIMETHYL β-OXOADIPATE

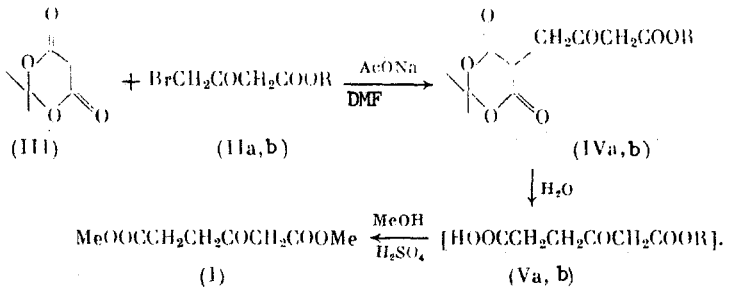
S. I. Zav'yalov, A. G. Zavozin, and N. E. Kravchenko

UDC 542.91:547.485.8

Acetoacetic ester and Meldrum's acid provide a new and simple synthesis of dimethyl β-oxoadipate. This compound is a synthone for some natural and biologically active compounds.

Dimethyl β-oxoadipate (I) is a synthone for isoretronecanol [1], some components of human blood [2], and the aza-analogs of prostaglandins [3].

In the present work we propose a new simple synthesis of (I), starting from alkyl γ-bromoacetoacetates (IIa, b) and Meldrum's acid (III) by the following scheme:



R = Me (a), Et (b).

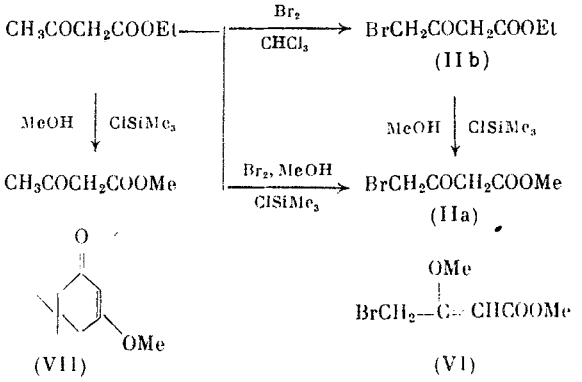
By the reaction of (III) with (IIa, b) in DMF in the presence of $AcONa \cdot 3H_2O$ we obtained the respective monoalkylation products (IVa, b); these were then cleaved according to [4] to form (Va, b), the monoesters of β-oxoadipic acid. Methanolysis of (Va) and (Vb) by a $MeOH-H_2SO_4$ mixture gave the desired diester (I) in an overall yield of 30% based on (IIa, b).

Bromoester (IIb) was obtained by bromination of acetoacetic ester in $CHCl_3$ according to [5]; bromoester (IIa) was obtained by bromination of acetoacetic ester in an $MeOH-ClSiMe_3$ mixture.

N. D. Zelinskii Institute of Organic Chemistry, Academy of Sciences of the USSR, Moscow.
Translated from Izvestiya Akademii Nauk SSSR, Seriya Khimicheskaya, No. 5, pp. 1227-1229, May, 1991. Original article submitted September 25, 1990.

 0568-5230/91/4005-1104$12.50

It is of interest that transesterification of (IIb) and of acetoacetic ester itself by MeOH–$ClSiMe_3$ proceeds with retention of the ketone group and without formation of the enol ether (VI); yet under the same conditions dimedon, a cyclic β-diketone, gives the corresponding enol ether (VII) in ~60% yield.



Thanks to its simplicity, the proposed synthesis of (I) can compete with those previously described [1, 6, 7].

EXPERIMENTAL

The IR spectrum was obtained in a KBr tablet with a UR-20 instrument; PMR spectra were obtained with a JEOL FX 90Q instrument. TLC was carried out on Silufol UF-254 (spots were developed with I_2 vapor and in UV light).

Methyl γ-Bromoacetoacetate (IIa). To a mixture of 16 ml (0.126 mole) of acetoacetic ester, 20 ml of $ClSiMe_3$, and 60 ml of MeOH was added, with cooling in ice and stirring, 6.4 ml (0.126 mole) of bromine over 10 min. The mixture was kept for 24 h at ~20°C and was then evaporated in vacuum, and the residue was distilled. There was obtained 19 g (77%) of (IIa), bp 100-103°C (10 mm), n_D^{23} 1.4772 [5]. R_f 0.68 [ethyl acetate (EA)]. PMR spectrum ($CDCl_3$, δ, ppm): 3.60 s ($COCH_2CO$), 3.70 s (CH_3O), 4.03 s ($BrCH_2CO$).

A mixture of 5 g of ethyl γ-bromoacetoacetate (IIb) [5], 4 ml of $ClSiMe_3$, and 10 ml of MeOH was held for 24 h at ~20°C. Distillation gave 3.8 g (82%) of (IIa), bp 103-106°C (12 mm).

Methyl Acetoacetate. To 3 ml of acetoacetic ester in 10 ml of MeOH was added 3 ml of $ClSiMe_3$. The mixture was held at ~20°C for 24 h, then it was evaporated and the residue was vacuum-distilled. There was obtained 2.2 g (80%) of methyl acetoacetate, bp 70-73°C (15 mm), n_D^{18} 1.4230 [8], R_f 0.53 (1:1 benzene–EA). PMR spectrum ($CDCl_3$, δ, ppm): 2.21 s (CH_3), 3.33 s ($COCH_2CO$), 3.55 s (CH_3O).

2,2-Dimethyl-5-(3-methoxycarbonyl-2-oxopropyl)-1,3-dioxane-4,6-dione (IVa). To a mixture of 5 g (0.035 mole) of Meldrum's acid (III), 4.9 g (0.036 mole) of $AcONa \cdot 3H_2O$, and 15 ml of DMF was added 7 g (0.036 mole) of (IIa). The mixture was stirred for 24 h at 20°C then treated with water and excess Na_2CO_3. Neutral components were extracted with EA. Then the alkaline solution was acidified with concentrated HCl and again extracted with EA. The extract was dried with $MgSO_4$ and evaporated in vacuum. There was obtained 8 g (89%) of (IVa), mp 83-87°C. R_f 0.58 (EA). PMR spectrum ($CDCl_3$, δ, ppm; J, Hz): 1.62 s (CH_3), 1.68 s (CH_3), 2.80 d (CH_2, J = 9), 3.55 s (CH_2), 3.60 s (CH_3O).

2,2-Dimethyl-5-(3-ethoxycarbonyl-2-oxopropyl)-1,3-dioxane-4,6-dione (IVb). Similar to the procedure described above, 4.5 g (0.031 mole) of (III) and 6.0 g (0.029 mole) of (IIb) in a mixture of 4 g (0.029 mole) of $NaOAc \cdot 3H_2O$ and 12 ml of DMF gave 6.3 g (81%) of (IVb), mp 54-58°C, R_f 0.65 (EA). PMR spectrum ($CDCl_3$, δ, ppm; J, Hz): 1.20 t (CH_3, J = 7), 1.68 s (CH_3), 1.74 s (CH_3), 2.85 d (CH_2, J = 9), 3.50 s (CH_2), 4.10 q (CH_2O, J = 7). Compounds (IVa) and (IVb) were used in the next step without additional purification.

Dimethyl β-Oxoadipate (I). A mixture of 6.6 g of (IVa) and 0.15 ml of water was heated for 0.5 h at 140-145°C (bath temperature). The mixture was cooled, treated with a mixture of 20 ml of MeOH and 2 ml of concentrated H_2SO_4, and held at ~20°C for 72 h. Then it was diluted with water, treated with excess $NaHCO_3$, and extracted with EA. The extract was dried with $MgSO_4$ and evaporated, and the residue was vacuum-distilled. There was obtained 1.8 g

(37%) of (I), bp 113-117°C (3 mm), n_D^{18} 1.4460 [7], R_f 0.75 (1:2 benzene–EA). PMR spectrum ($CDCl_3$, δ, ppm): 2.65 m (CH_2CH_2), 3.48 s (CH_2), 3.60 s (CH_3O), 3.67 s (CH_3O). IR spectrum (ν, cm^{-1}): 1720 (C=O), 1740 ($COOCH_3$).

Similarly, 6 g of (IVb) gave 1.7 g (41%) of (I), bp 113-117°C (3 mm).

1-Methoxy-5,5-dimethylcyclohexen-3-one (VII). A mixture of 2 g of dimedone, 2.5 ml of $ClSiMe_3$, and 9 ml of MeOH was stirred for 24 h at ~20°C, then treated with water and excess K_2CO_3. The solution was extracted with ether, and the extract was dried with K_2CO_3 and evaporated. The residue was vacuum-distilled to yield 1.3 g (59%) of (VII), bp 150-151 °C (20 mm), n_D^{20} 1.4917 [9], R_f 0.70 (EA). PMR spectrum ($CDCl_3$, δ, ppm): 1.00 s ($2CH_3$), 1.98 s (CH_2), 2.10 s (CH_2), 3.57 s (CH_3O), 5.33 s (CH).

LITERATURE CITED

1. J. R. Celerier, M. Haddad, D. Jacoby, and G. Lhommet, Tetrahedron Lett., 28, No. 52, 6597 (1987).
2. J. Pfordt, H. Thoma, and G. Spiteller, Ann., No. 12, 2298 (1981).
3. R. L. Smith, T. J. Lee, N. P. Gould, et al., J. Med. Chem., 20, No. 10, 1292 (1977).
4. S. I. Zav'yalov, G. I. Ezhova, and N. E. Kravchenko, Izv. Akad. Nauk SSSR, Ser. Khim., No. 3, 667 (1987).
5. A. Svendsen and P. M. Boll, Tetrahedron, 29, No. 24, 4254 (1973).
6. E. C. Taylor and A. McKillop, Tetrahedron, 23, No. 2, 897 (1967).
7. B. J. Whitlock and H. W. Whitlock, J. Org. Chem., 39, No. 21, 3144 (1974).
8. T. Peters, Liebigs. Ann., 257, 355 (1890).
9. J. Lessard, Phan Viet Minh, Minh Tan, et al., Can. J. Chem., 55, No. 6, 1015 (1977).

THE FIRST EXAMPLE OF AN ENE REACTION BETWEEN AN ESTER OF CYCLOPROPENECARBOXYLIC ACID AND AN ALKYNE

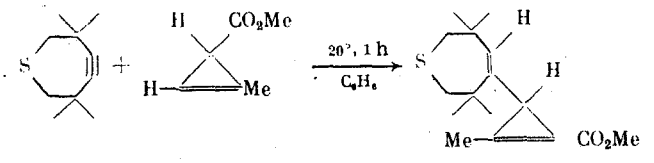
M. N. Protopopova and A. M. Gal'minas

UDC 542.91:547.512:547.314

Methyl cyclopropenecarboxylate (I) enters into the ene reaction with the cyclic acetylene (II), giving vinylcyclopropene (III) with a high yield.

Examples of ene reactions of cyclopropenes, where acetylenes act as enophile, are extremely few in number [1]. Thus, 1-methylcyclopropene enters into ene reactions with perfluorobutyne and dimethyl acetylenedicarboxylate [1]. As far as 3-substituted cyclopropenes are concerned, only the reaction of 3-methoxycarbonyl derivatives of the ene type with dehydrobenzene in situ is known [1-4], whereas there are no examples of such reactions with stable acetylenes in the literature.

We have demonstrated for the first time the possibility of realizing an ene reaction of 3-substituted cyclopropene and a stable acetylene. Thus, it was found that the reaction of equimolar amounts of methyl cyclopropenecarboxylate (I) [5] and 3,3,6,6-tetramethyl-1-



(I) (II) (III)

N. D. Zelinskii Institute of Organic Chemistry, Academy of Sciences of the USSR, Moscow.

Translated from Izvestiya Akademii Nauk SSSR, Seriya Khimicheskaya, No. 5, pp. 1229-1230, May, 1991. Original article submitted December 11, 1990.

0568-5230/91/4005-1106$12.50