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A SIMPLE SYNTHESIS OF 2-AZIDO-2-ALKENOATES

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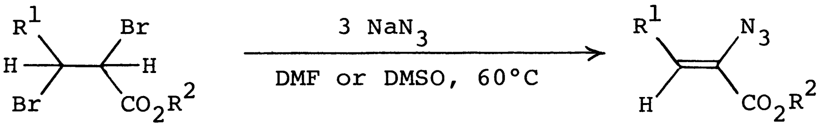
The title compounds are derived from 2,3-dibromoalkanoates by treatment with 3 equivalents of sodium azide.

2,3-Dehydro-2-amino acid is an important constituent of biologically active peptides.1) Recently, increasing attention is focused on this compound not only from the view-point of its physiological features,2) but also as an achiral source for preparation of optically active amino acids.3) The title compounds are well known as the useful intermediates for this class of compounds4) and also expected to exhibit unique reactivities due to their multi-functions.5) We report herein a convenient synthetic method for 2-azido-2-alkenoates (I) starting from 2,3-dibromoalkanoates (II) which in turn are produced by bromination of corresponding 2-alkenoates.6)

Treatment of II with 3 equivalents of sodium azide in aprotic polar solvent such as dimethylformamide (DMF) or dimethylsulfoxide (DMSO) for 12 hr at 60°C, followed by work-up consisted of dilution with ether, washing the organic layer with water and concentration under reduced pressure, gave I as practically pure material.7) Typical results are summarized in Table I. The products showed correct IR and H^1-NMR spectra and, in cases of Ib∿Id, were stereochemically uniform judging from their H^1-NMR spectra. In order to determine the stereochemistry of the products, Ib was transformed into the corresponding N-chloroacetyl-2-amino-2-alkenoate according to the reported procedure.4, 8) On the basis of its H^1-NMR spectrum, (Z) structure was assigned to the products Ib∿Id.

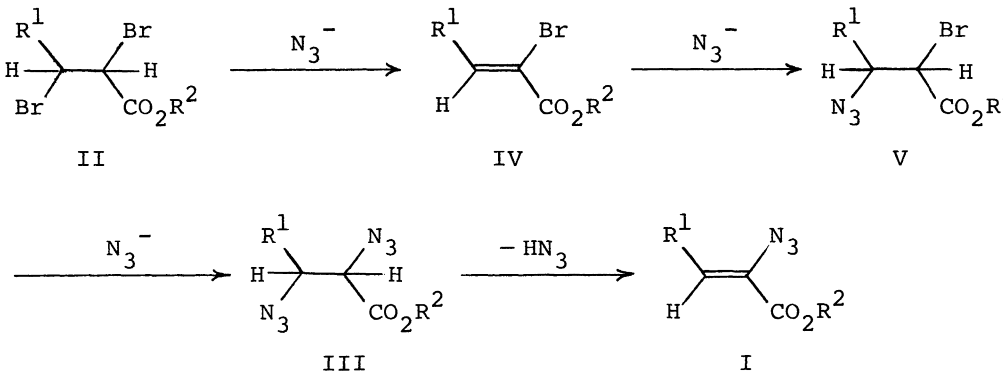


II I

Table I. Preparation of 2-azido-2-alkenoates9)

	R^1	R^2	Solvent	Yiled(%) of I	IR (neat, cm^{-1}); ^{1}H-NMR ($CDCl_3$, δ)
a	H	C_2H_5	DMF	71	2125, 1730, 1625; 5.32 (d, J = 1 Hz), 5.82 (d, J = 1 Hz)
b	CH_3	C_2H_5	DMF	80	ref 4
c	C_2H_5	CH_3	DMF	86	2150, 1730, 1640; 6.17 (t, J = 6 Hz)
d	C_6H_{11}	CH_3	DMF	86	2150, 1720, 1640; 6.05 (d, J = 8 Hz)
d	C_6H_{11}	CH_3	DMSO	87	

The reaction of IIa with sodium azide (3 equiv.) at 20°C in DMF for 5 hr gave ethyl 2,3-diazidopropionate IIIa (IR 2100 $\mathrm{cm^{-1}}$) in quantitative yield. Treatment of IIb with sodium azide under the same conditions produced ethyl 2-bromo-2-butenoate IVb. Upon treatment with 1,8-diazabicyclo[5.4.0]undecene (DBU) in ether IIIa was transformed into Ia (IR 2125 $\mathrm{cm^{-1}}$) in 93% overall yield from IIa. By the use of 1 equivalent of sodium azide in DMF at 25°C, IIa was converted into ethyl 2-bromopropenoate IVa. Thus, the reaction mechanism from II to I can be understood in terms of the following scheme. Dehydrobromination of II is effected by sodium azide to give IV, to which conjugate addition of azide anion occurs to afford V. The remaining bromine atom in V is then substituted by azide to give III, from which HN_3 eliminates to afford I.



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4) C. Shin, Y. Tonezawa, K. Unoki, and J. Yoshimura, Bull. Chem. Soc. Jpn., 52, 1657 (1979).
5) One of the possible characters of I is the reactivity as vinyl azide: see A. Hassner and B. A. Belinka, Jr., J. Am. Chem. Soc., 102, 6185 (1980).
6) Transformation of some 2,3-dibromo ketones into 2-azido-2-alkenyl ketones is reported: G. L'abbé and A. Hassner, Angew. Chem., Int. Ed., 10, 98 (1971).
7) Treatment of the bromine adduct of methyl cinnamate or ethyl senecioate with sodium azide produced 2-bromoalkenoates corresponding to IV: Cf. G. L'abbé, M. J. Miller, and A. Hassner, Chem. and Ind., 1970, 1321.
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9) As attempted distillation of Ia induced severe explosion, purification of these azides should avoid heating.

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