NMR ($CDCl_3$) δ: 2.76 (1H, d, $J_{cis}=5.0$ Hz, C_3–$\underline{H}$), 2.87 (1H, d, $J_{trans}=11.0$ Hz, C_3–$\underline{H}$), 3.83, 3.88, 3.94 (each 3H, s, $OC\underline{H}_3$), 5.19 (4H, s, $2\times OC\underline{H}_2$–Ar), 5.28 (1H, dd, $J_{trans}=11.0$ Hz, $J_{cis}=5.0$ Hz, C_2–$\underline{H}$), 6.32 (1H, s, C_8–$\underline{H}$), 6.99—7.52 (13H, m, Ar–$\underline{H}$).

The General Oxidative Method of Conversion of Flavanone to Flavones——A mixture of flavanone (I—VIII) 0.5 mmol, 2,3-dichloro-5,6-dicyanobenzoquinone (DDQ) 147 mg (0.65 mmol) and dry dioxane 15 ml was refluxed. The dark brown solution was gradually decolorized to pale yellow. After 5—12 hr (the reaction mixture was sometimes checked by TLC), the oxidative reaction was completed (see Table I). The reaction mixture was cooled and the precipitated 2,3-dichloro-5,6-dicyanohydroquinone (usually pale brown plates) was filtered off. The filtrate was concentrated *in vacuo* and chromatographed. The corresponding flavone were obtained quantitatively. Each flavone was identified with authentic samples[9–13] by mixed mp, TLC and IR.

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Stereochemical Studies. LI.[1] Stereochemical Courses of Deaminative Bromination of L-Aspartic Acid and Its Esters

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Stereochemical studies on the deaminative bromination of L-aspartic acid (**1a**) and its esters (**1b**, **1c**, and **1d**) have shown that α-carboxyl group almost completely holds the configuration in this substitution reaction, while β-carboxyl group has no ability to exhibit such neighboring group participation.

Keywords——deaminative bromination; L-aspartic acid esters; neighboring group participation; stereochemistry; absolute configuration; bromosuccinic acid

Nitrous acid deamination of optically active α-amino acid having a hydrogen and having no aryl group at the asymmetric α-carbon atom is known to give the corresponding α-substituted acid with retention of configuration, due to the participation of the neighboring α-carboxyl group.[3] The present paper describes the results of deaminative bromination of L-aspartic acid (**1a**) and its esters (**1b**, **1c**, and **1d**) to study whether the β-carboxyl group shows such neighboring group participation and what is the stereochemical course in the co-existence of α- and β-carboxyl group.

Absolute configuration of dimethyl bromosuccinate (2), the final product in the present deaminative bromination followed by esterification as shown in Chart 1, has already been established[4] by chemical correlation to the known[5] (*S*)-2-bromosuccinamic acid as shown in Chart 2.

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1) Part L: K. Tomioka, K. Koga, and S. Yamada, *Chem. Pharm. Bull.* (Tokyo), **25**, 2689 (1977).

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4) *a*) P. Walden, *Ber.*, **28**, 2766 (1895); *b*) L.J. Andrews and J.E. Hardwicke, *J. Am. Chem. Soc.*, **74**, 3582 (1952).

5) Y. Murakami and Y. Iitaka, *Chem. Pharm. Bull.* (Tokyo), **17**, 2397 (1969).

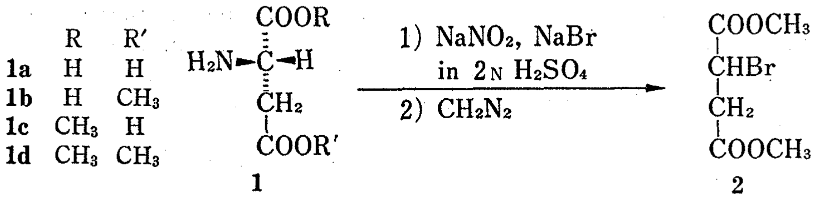

Chart 1

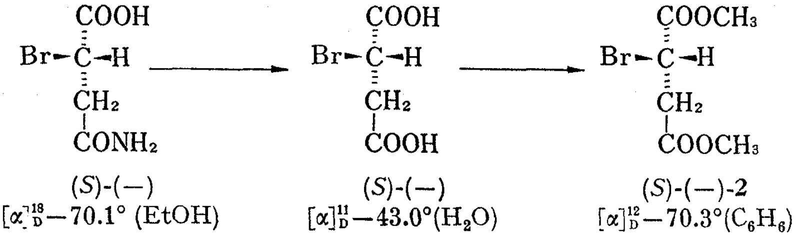

Chart 2

Deaminative bromination of **1a**⁶⁾ and its diethyl ester⁷⁾ was reported several decades ago, but quantitative analyses of the stereochemical courses have not yet been performed. It now becomes apparent from Table I that the existence of the α-carboxyl group (**1a** and **1b**) almost completely holds the configuration during deaminative bromination, while the reaction proceeds with inversion accompanied by much racemization (24% net inversion) in cases of α-esters (**1c** and **1d**)⁸⁾ regardless of the existence of the carboxyl group or the ester group at β-position. The present experiments clearly demonstrate that β-carboxyl group has no ability to exhibit neighboring group participation in deamination reaction.

TABLE I. Stereochemical Course of Deaminative Bromination

Starting material	2		
	Chemical yield (%)$^{a)}$	Specific rotation$^{b)}$ (in benzene)	Stereochemical course$^{c)}$
1a	65	$[\alpha]_D^{9}$ −70.3°	100% retention
1b	74	$[\alpha]_D^{24}$ −68.8°	98% retention
1c	25	$[\alpha]_D^{18}$ +16.9°	24% inversion
1d	33	$[\alpha]_D^{14}$ +16.9°	24% inversion

a) Isolated yield after column chromatography. *b*) Data on the purified sample after distillation.
c) Based on $[\alpha]_D$ −70.3° (benzene) for optically pure (*S*)-2.

Experimental

Materials——Starting materials (**1b**,⁹⁾ **1c**,¹⁰⁾ and **1d**¹¹⁾) were prepared according to the reported method from L-aspartic acid (**1a**) of $[\alpha]_D^{14}$ +24.8° (*c*=1.004, 1 N HCl).

General Procedure for Deaminative Bromination——To an ice-cooled solution of **1a**—**1d** (15 mmol) and NaBr (60 mmol) in 2 N H_2SO_4 (37.5 ml) was added $NaNO_2$ (18 mmol) in portions during 30 min, and the whole was stirred for 30 min. After addition of urea to decompose excess reagent, the reaction mixture was extracted with ether. The combined extracts were washed with a small amount of water and dried over anhyd.

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6) B. Holmberg, *Ber.*, **60**, 2198 (1927).
7) E. Fischer and K. Raske, *Ber.*, **40**, 1051 (1907).
8) Low chemical yields in these cases are due to the formation of the elimination products.
9) *a*) D. Coleman, *J. Chem. Soc.*, **1951**, 2294; *b*) J.F. Biernat, B. Rzeszotarska, and E. Taschner, *Ann.*, **646**, 125 (1961).
10) *a*) J. Kovacs, H.N. Kovacs, I. Koenyves, J. Csaszar, T. Vajda, and H. Mix, *J. Org. Chem.*, **26**, 1084 (1961); *c*) J. Kovacs, H.N. Kovacs, and R. Ballina, *J. Am. Chem. Soc.*, **85**, 1839 (1965).
11) E. Fischer and E. Koenigs, *Ber.*, **40**, 2048 (1907).