Chiral Recognition of a Prochiral (*meso*-Carbon) Centre by $\Lambda(-)_{436}$-α-*l*,*l*-2,9-diamino-4,7-diazadecanecobaltate

By ROBERT JOB and THOMAS C. BRUICE*

(*Department of Chemistry, University of California, Santa Barbara, California* 93106)

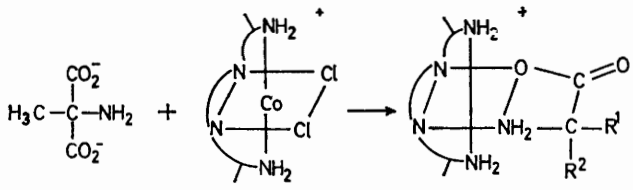
Summary One hundred per cent chiral differentiation of the prochiral carboxyl groups and 65% steric induction is observed in the complexing of $\Lambda(-)_{436}$-α-*l*,*l*-2,9-diamino-4,7-diazadecanecobaltate with aminomethylmalonate and decarboxylation of the resultant $\Lambda(-)_{436}$-α-[*l*,*l*-2,9-diamino-4,7-diazadecanecobalt(III)-*R*-malonate]$^+$ to $\Lambda(-)_{436}$-α-[*l*,*l*-2,9-diamino-4,7-diazadecanecobalt(III)-*S*-alanine]$^{2+}$, respectively.

CHIRAL recognition of prochiral (*meso*-carbon) centres (*Caabc*) is a general feature of enzymatic reactions[1] which has not been convincingly established in non-enzymatic reactions.[2] In this study, the α-product formed on complexation of a malonic acid to an α-dissymmetric Co^{III} centre is shown to arise *via* 100% chiral differentiation of the two carboxylate moieties. Furthermore, decarboxylation of the product was found to be under stereochemical control of the dissymmetric Co^{III} to yield diastereomeric alanine complexes of which the *S*-alanine complex represents 65%.

When α,α-aminomethylmalonate (**1**) is treated with complex (**2**), two *cis*-α products are possible (**3a**,**b**) (Scheme) depending on which carboxylate group is bound. Complex (**3a**) contains the malonate in the *R*-configuration whereas (**3b**) contains the malonate moiety in the *S*-configuration.

The c.d. curve of the *S*-alanine complex (**3c**) exhibits four well defined bands in the 600—300 nm region [498 (+), 437 (−), 368 (+), 322 nm (−)]. The c.d. curve of the *R*-alanine (**3d**) reveals that the band at 437 nm has changed

sign and is included under the envelope of the principal c.d. band at 498 nm; also, the band at 368 nm has either changed sign or disappeared completely.



SCHEME

The c.d. curve of (**3a,b**) prepared (73·4%) from (**1**) and (**2**) in refluxing ethanol, except for the magnitude of $M\theta$, is identical to the c.d. curve of (**3d**) clearly revealing that the malonate group possesses the *R*-configuration. A further indication of isomeric purity is that the c.d. curve is not altered upon recrystallization of the product from water as the perchlorate hemihydrate.†

Treatment of (**1**) with (**2**) in refluxing methanol decreased the yield of (**3a**) but allowed for recovery of 99% of the cobalt species as identifiable products. Ion-exchange chromatography revealed that all the *cis*-α-product contained malonate in the *R*-configuration (**3a**). The remaining cobalt species were a mixture of side products resulting from an isomerisation of the tetramine ligand around the cobalt centre during the course of the reaction.

The stereoisomeric identity of (**3a**) is largely retained as it undergoes decarboxylation to yield a mixture composed of 65% (**3c**) and 35% (**3d**), as determined quantitatively by n.m.r. and rotatory dispersion measurements. (Complete retention of configuration would result in *R*-malonate going to *S*-alanine.) Since the sp^3 malonate carbon becomes sp^2 during decarboxylation, this result establishes steric induction (by the dissymmetric Co^{III} group) in the protonation of the intermediate.

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† A satisfactory elemental analysis was obtained.

[1] A. G. Palekar, S. S. Tate, and A. Meister, *Biochemistry*, 1971, **10**, 2180; R. W. Swido and A. N. Kao, *J. Biol. Chem.*, 1954, **206**, 883; S. G. Cohen and L. Altschul, *Nature*, 1959, **183**, 1678.

[2] P. S. Schwartz and H. E. Carter, *Proc. Nat. Acad. Sci. U.S.A.*, 1954, **40**, 499; R. Altschul, P. Bernstein, and S. G. Cohen, *J. Amer. Chem. Soc.*, 1956, **78**, 5091.