Stereoselective Decomposition of an Octahedral Complex during Bacterial Growth

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Summary Stereoselective metabolism of 1,2,6-trisglycinatocobalt(III) has been demonstrated during the growth of a soil bacterium on synthetic media.

THE METABOLISM of inorganic complexes by micro-organisms has received comparatively little attention. Various cobalt ammines have been used as nitrogen sources for fungi.[1] Bailar *et al.*[2] have reported the growth of *Pseudomonas aeruginosa* on D-$[Co(en)_3]Cl_3$ as sole nitrogen source.

The effect of NH_4Cl *concentration on the % of complex metabolized and overall stereoselectivity after* 165 *hr. incubation at* 30°

Case	% w.v. NH_4Cl	% Complex metabolized	Optical purity of remaining complex	Relative rates of enantiomer metabolism (−) : (+)
1.	0·003	30·5	28·8	4·9 : 1
2.	0·030	36·9	19·3	2·0 : 1
3.	0·10	46·8	16·3	1·5 : 1

The L-form is inhibitory and growth on the racemate is not observed. Stereoselective effects have also been demonstrated[3] in the absorption of $[Ru^{II}(phen)_3](ClO_4)_2$ across biological membranes. Selective decomposition of one enantiomer of an organic racemate by micro-organisms was reported by Pasteur.[4] This method has not been successfully applied to the preparation of optically active material from inorganic racemates.[5]

We have studied the use of several Co^{III} complexes as nitrogen sources for bacterial growth and have several strains, isolated from soil, which will effect the breakdown of these kinetically inert species. We report here a bacterial system capable of producing optically active material of considerable purity.

When our strain G, a facultative anaerobe, is grown anaerobically in a synthetic medium containing glucose as carbon source and racemic α-$Co(gly)_3$ as sole nitrogen

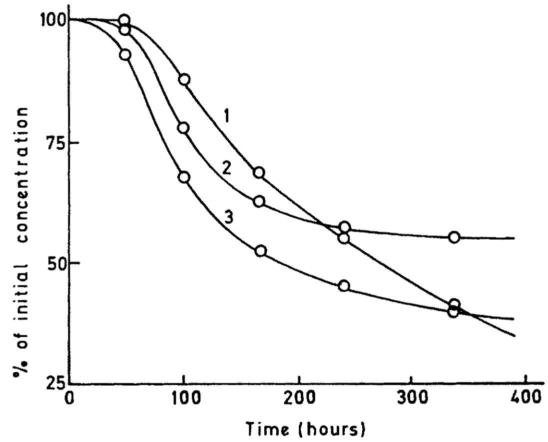

FIGURE. *Graph showing the % complex remaining against time. Case* 1, 0·003%; 2, 0·03%; 3, 0·10% *w.v.*, NH_4Cl.

source, both growth and utilization of the complex are very slow. The addition of ammonium chloride to the culture medium effects an increased rate of growth and metabolism of the complex (see Figure). As the optical density of the visible band decreases, the c.d. spectrum begins to show a marked Cotton effect corresponding to α-(+)-[Co(gly)$_3$]. Using an estimated *g* value, the provisional figures in the Table were derived. Thus the larger the NH_4Cl concentration the smaller the overall stereoselectivity. In case 1, initial removal of complex appears to be stereospecific.

Optically active material of approximately 60% optical purity has been obtained in this way. During bacterial growth, red crystals of cobaltous phosphate accumulate in the medium—a phosphate buffering system being used. Under aerobic conditions no apparent metabolism of the complex occurs.

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[1] K. Kinoshita, *Acta Phytochim.*, 1927, **3**, 31 (*Chem. Abs.*, 1928, **22**, 1990).
[2] J. C. Bailar, jun., H. Itatani, M. J. Crespi, and J. F. Geldard, "Advances in Chemistry," 1967, **62**, 103.
[3] J. H. Koch, W. P. Rogers, F. P. Dwyer, and E. C. Gyarfas, *Austral. J. Biol. Sci.*, 1957, **10**, 342.
[4] L. Pasteur, *Compt. rend.*, 1858, **46**, 615.
[5] S. Kirschner, "Preparative Inorganic Reactions," ed. William L. Jolly, *Interscience*, New York, vol. 1, 1964, p. 38.