THE MOLECULAR STRUCTURE OF A NOVEL SIDEROPHONE, NEOCOPROGEN I, \( \text{C}_{34} \text{H}_{47} \text{N}_{6} \text{O}_{12} \text{Fe} \)

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The coprogen family of siderophores (microbial iron chelating agents) are built up of typical units as in other fungal siderophores. Coprogen, like ferrribin, is built from 6-ß-hydroxy ornithine and trans-3-hydroxy-3-methylvaleric acid (trans 3-methyl-5-hydroxy-pent-2-enoic acid), but these building blocks are arranged in a completely different manner from that in ferrrobatin. Two of the amino acids are linked together, head to head, through a diketo-piperazine ring, and the third is linked to the rest of the molecule via an ester linkage. Other members in the coprogen family are coprogen B, rhodotorulic acid and dimeric acid, but no crystal structure for any of these compounds, either as liquid or complex, have been reported. We report here the isolation and structure determination of a novel member in this family, neocoprogen I.

The compound was isolated from iron-deficient cultures of Curvularia subulata, which also produce coprogen, ferrribin and a few other minor siderophores. It was purified by reversed phase chromatography using C_{18} bonded silica gel as the stationary phase and methanol-water gradient as the mobile phase, and was crystallized from an ethanol solution equilibrated with acetonitrile at 138K, by direct methods and difference syntheses, final R=0.325.

Neocoprogen I differs from coprogen and coprogen B in having dissimilar acyl groups (\( \text{C}_{31} \text{H}_{47} \text{N}_{6} \text{O}_{12} \text{Fe} \)) in Fig.1, while the former have three identical acyl groups (\( \text{C}_{31} \text{H}_{47} \text{N}_{6} \text{O}_{12} \text{Fe} \)) in Fig.1, while the former have three identical acyl groups (\( \text{C}_{31} \text{H}_{47} \text{N}_{6} \text{O}_{12} \text{Fe} \)) in Fig.1, while the former have three identical acyl groups (\( \text{C}_{31} \text{H}_{47} \text{N}_{6} \text{O}_{12} \text{Fe} \)).

The presence of different N-acyl groups in the same siderophore has recently been reported for the first time in the case of the asperchrome series (N.A.F. Jalal and C.L. Barnes, J. Bact. 1984, in press), and the present structure provides further evidence of the versatility in siderophore structures of this type.

The crystallographic data for the three compounds are given below. L-Histidine Nitrate, \( \text{C}_{6} \text{H}_{17} \text{N}_{2} \text{O}_{3} \cdot \text{NO} \), \( a = 5.24(2) \), \( b = 7.11(2) \), \( c = 10.40(3) \), \( \beta = 115.0(3) \), \( V = 906.2 \text{A}^3 \), \( \rho_{c} = 1.55 \text{g/cm}^3 \), space group \( \text{P2}_{1} \text{2}_{1} \text{2}_{1} \), \( Z = 4 \); Structure from MULTAN final R-value 0.064 for 792 reflections. L-Phenylalanine Nitrate, \( \text{C}_{9} \text{H}_{11} \text{NO} \cdot \text{NO} \), \( a = 14.93(2) \), \( b = 5.37(1) \), \( c = 21.51(1) \), \( \beta = 107.78(1) \), \( V = 956.1 \text{A}^3 \), \( \rho_{c} = 1.5800 \text{g/cm}^3 \), space group \( \text{P2}_{1} \text{2}_{1} \text{2}_{1} \), (two molecules of phenylalanine and one nitrate group in the asymmetric unit); Structure from MULTAN, final R-value 0.067 for 3230 reflections (1826 > 20); Structure from MULTAN, final R-value 0.067 for 3230 reflections (1826 > 20).

The sallent features that emerge from the above structural investigations are: (i) The three N-O bonds are quite unequal in length. The three N-O distances are 1.331, 1.303, 1.187A in His NO; 1.264, 1.235, 1.229A in Met NO; and 1.235, 1.129 in PheNO. There is a correlation between the stretching of the N-O bonds and the number and length of hydrogen bonding. Hence the nitrate group does show some deviations from its classical D_{3h} symmetry since the oxygen attached to the nitrate group are non-equivalently bonded to the nitrogen atom. (ii) In PheNO we have molecules of phenylalanine and one nitro group in the asymmetric unit but surprisingly the carboxyl groups have nearly identical geometry. Although the two molecules have similar conformations, there are some essential differences.

The torsion angles \( \psi_{1} \) and \( \psi_{2} \) are, respectively, -81 and 173.2° in molecule A and 1.8 and 179.7° in molecule B. In molecule A, the amino nitrogen is 0.18A away from the plane of the carboxyl group whereas in molecule B the amino nitrogen is the plane of the carboxyl group. The deviation of the amino nitrogen atom are -0.628 and 0.91A in Met NO; and His NO; respectively. (iii) There are two bifurcated hydrogen bonds involving the amino group. In PheNO, one of the hydrogens of the amino group of molecule A takes part in a bifurcated interaction with one of the oxygens of the nitrogro and the carbonyl oxygen of the other molecule B. In MetNO, one of the nitrogen atoms of the amino group takes part in a bifurcated hydrogen bond with two of the oxygens of two symmetry related nitro groups.

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