priority change corresponds to *R on the growing chain* of the saturated fatty acid **7**. As expected,[7a,d] C-2 of **12** (corresponding to C-12 of **8**) has *R* configuration.

The results show *opposite stereochemistry of acetate-derived deuterium* for fatty acid biosynthesis and polyketide (cladosporin (**1**)) formation. Interestingly, the absolute stereochemistry of single carbon–oxygen bonds of **1** derived intact from acetate at C-14 and C-3 corresponds to *S* on the growing chains (i.e., **4**), again opposite to that expected (*R*) in fatty acid biosynthesis.[7] The same phenomenon can be seen at certain sites in the macrolide antibiotic brefeldin A[6] and has been observed in two other fungal systems in our laboratories.[14]

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Supplementary Material Available: Experimental procedures for production of **1**, **2**, and **9–13c** and for acquisition of NMR spectra (9 pages). Ordering information is given on any current masthead page.

Stereochemical Features of Enoyl Thiol Ester Reductase in Averufin and Fatty Acid Biosynthesis in *Aspergillus parasiticus*

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Identification of starter units and the mechanism(s) of their homologation, typically by malonylCoA or its alkylated derivatives, are issues central to understanding polyketide biosynthesis. We have described the intact incorporation (3–4%) of [1-^{13}C]hexanoic acid into the side chain of averufin (**2**), accompanied by a 0.5–1%/site secondary incorporation of label throughout the molecule after β-oxidation to [1-^{13}C]acetate.[1,2] Alternative C_4–C_8 acids suffered only degradation to acetate and secondary incorporation at levels comparable to that from hexanoate.[2] On the basis of these findings and the demonstrated roles of aryl[3] and branched chain[4] starters, we proposed, but could not strictly prove, that hexanoylCoA served as the primer of the aflatoxin B_1 biosynthetic pathway (path A, Scheme I). Recently, Simpson has described[5] the incorporation of diethyl [2-^{13}C]malonate into averufin at a uniform level, save a lower rate of incorporation at C-6′. These observations were consistent with an acetate "starter effect"[6] and were interpreted to support path B (Scheme I) to averufin as a decaketide rather than as a heptaketide primed by hexanoylCoA (path A). The uniform level of ^{13}C-label seen in this experiment, however, may simply reflect an intracellular pool-size effect and its extent of enrichment by exogeneous labeled malonate affecting polyketide and fatty acid biosynthesis equally. Nonetheless, the possibility cannot be excluded that hexanoylCoA generated in vivo may reversibly exchange with a synthetase that normally produces this segment from acetate and malonate, e.g., **1**. The well-established observation that thioesters can exchange in this manner in fatty acid biosynthesis[7] has been extended in the last year to macrolides[8] and suggests that hexanoate could behave similarly in averufin biosyhthesis.

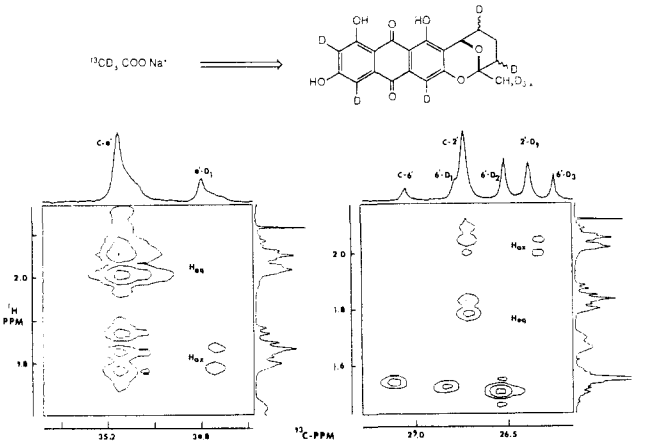
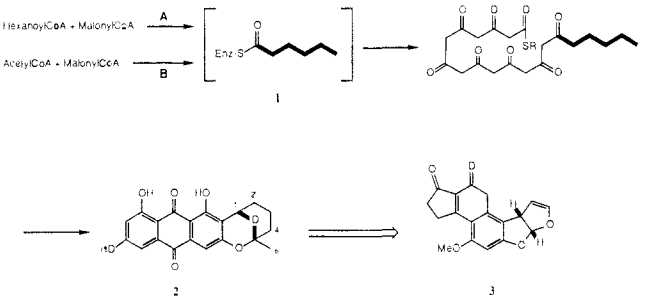


Figure 1. ^{2}H decoupled ^{1}H,^{13}C chemical shift correlation plots of averufin from the incorporation of [2-$^{2}H_3$,^{13}C]sodium acetate for C-4′ (left) and C-2′ and C-6′ (right).

Scheme I



In this paper we apply the useful technique of ^{2}H decoupled ^{1}H,^{13}C heteronuclear shift correlation spectroscopy[9] to examine the stereochemical fate of [2-$^{2}H_3$,^{13}C]acetate in oleic acid and averufin **2** biosynthesis. While the second reductive enzyme of fatty acid biosynthesis, enoyl thiol ester reductase, is stereochemically variable across a wide range of organisms,[10] for the imperfect fungi, which are notable producers of polyketide natural products, deuterium from [2-$^{2}H_3$,^{13}C]acetate assumes the *R* configuration in the growing fatty acid chain in the cases that have been examined to date. For the averufin-accumulating mutant

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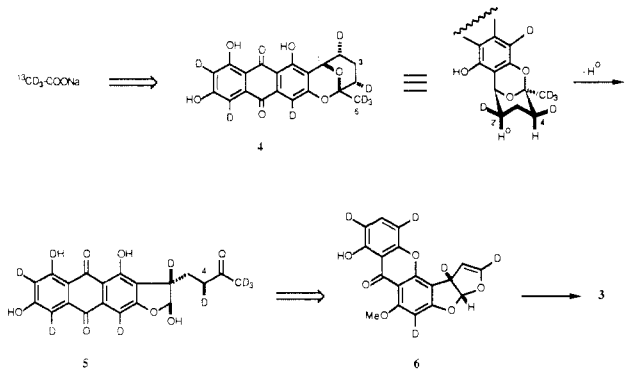
Scheme II



of *Aspergillus parasiticus* we demonstrate that this pattern is maintained not only in oleic acid but also in the six-carbon side chain of averufin.

[2-$^2H_3$, ^{13}C]Sodium acetate (35 mg) was administered to each of three 48-hour-old standing cultures of the averufin-accumulating mutant of *A. parasiticus* (ATCC 24551) grown in a low salts medium[11] (50 mL/250 mL Erlenmeyer flask). Similar additions were made every 24 h to a cumulative dose of 140 mg/flask. After the sixth day, the mycelial mats were collected, and the averufin produced was extracted and purified as previously described.[1,2] The rigid bicyclic ketal of averufin **4** provides an excellent system to apply the ^2H decoupled ^1H, ^{13}C chemical shift correlation method of Vederas[9] to determine the relative orientations of deuterium from labeled acetate. The H-2', -3', and -4' methylene hydrogens give rise to resonances separated by >0.1 ppm from their geminal partners. These signals have been unambiguously assigned.[12] The result of the correlation experiments is shown in Figure 1 where the spectrum at the left shows CH_2-4' in which the upfield correlation from CHD-4' indicates that the methylene hydrogen is axial. Similarly, in the spectrum at the right correlations for C-6' and C-2' overlap somewhat in the carbon domain but are well-separated in the proton domain. Once again, hydrogen orientation at CHD-2' is axial. Therefore, the deuterium orientation at both C-2' and C-4' is equatorial. Knowing further the absolute configuration of averufin as 1'*S*,[13] the absolute configuration of deuterium label at C-2' and C-4' may be assigned *R* in the growing fatty acid/polyketide chain. In parallel experiments oleic acid from the mutant grown in the presence of [2-$^2H_3$, ^{13}C]acetate was isolated, degraded, and analyzed essentially as described in the accompanying communication.[14] In keeping with fatty acids derived from other fungal sources,[10] the locus of deuteriation was found to be *R* in the growing chain.

Several conclusions may be drawn from these experiments. First, that a common stereochemical course is observed in the reductive formation of the six-carbon side chain of averufin and oleic acid isolated from the same organism is consistent with but does not absolutely require a hexanoylCoA primer in the aflatoxin pathway. Second, the collected findings of the preceding paper[14] are that the corresponding reductions in metabolites of clear polyketide origin take place with the opposite stereochemical course to their co-occurring fatty acids. While the present sample is admittedly small and subject to stereochemical exception in the future, it lends empirical support to the proposed role of a hexanoyl starter and may prove general for (some) species of *Fungi imperfecti*. Third, the first oxidative step in the conversion of the averufin side chain to the dihydrobisfuran characteristic of the aflatoxin pathway involves an apparently direct oxidative rearrangement of the former to 1'-hydroxyversicolorone (**5**).[15] The two deuteria present[16] at C-2'and C-4' in **4** are known to appear in the bisfuran, as established for sterigmatocystin (**6**).[17] Therefore, in the rearrangement of **4** to **5**, it is the axial hydrogen at C-2' (H°) in averufin that is lost in this process, trans diaxial to the migrating aryl ring, in accord with stereoelectronic considerations (Scheme II).[1,18]

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$Tl_2Pt(CN)_4$: A Noncolumnar, Luminescent Form of $Pt(CN)_4^{2-}$ Containing Pt-Tl Bonds

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The ability of $Pt(CN)_4^{2-}$ to form columnar structures with varying Pt-Pt interactions in both simple salts[1] and in the partially oxidized, one-dimensional conducting materials is well known.[2] For simple salts, with metal cations, the observed Pt-Pt separations in 20 crystallographically studied examples cover a wide range, 3.09-3.75 Å,[1] while in the partially oxidized materials the corresponding separations are shorter and fall into a narrower range, 2.8-3.0 Å.[2] Only with large organic cations, the radical cation of *N,N,N',N'*-tetramethylbenzenediamine[3] and 1,1'-dimethyl-4,4'-bipyridinium,[4] do $Pt(CN)_4^{2-}$ units exist as well-separated, square-planar ions. We report here on the novel structure of $Tl_2Pt(CN)_4$ which does not possess the usual columnar structure, but which exhibits covalent Pt-Tl bonding.

Slow diffusion of an aqueous solution of $TlNO_3$ into an aqueous solution of $K_2[Pt(CN)_4]\cdot 3H_2O$ at 23 °C produces colorless crystals of $Tl_2Pt(CN)_4$.[5-10] These crystals show an intense blue luminescence at 22 500 cm^{-1} (width at half height, 2860 cm^{-1}) at 298 K when irradiated in the near ultraviolet. The emission spectrum is shown in trace A at the top of Figure 1 while the excitation spectrum is shown in trace B. The excitation band correlates well with the absorption spectrum obtained from a

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