range of backgrounds (3.4×10–5 cd/m^2 to 440 cd/m^2). Other results suggest that the range of backgrounds may be more limited. For example, when WINTERS, POLLACK and HICKLEY[27] examined the responses of transient and sustained cells to a standing contrast they found response differences to be minimal at a low -1.76 log cd/m^2 and high (1.23 log cd/m^2) adaptation level. Response differences were clearer at a medium (0.23 cd/m^2) adaptation level.

The most convincing argument for two types of cells would come from experiments which unequivocally demonstrate that the neural pathways through the retina are different for transient and sustained cells. This would require experiments in which the microscopic anatomy of the retina is correlated with intracellular recordings from the various types of cells in the retina, as described earlier for the *Necturus*.

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Résumé

De récentes recherches sur les cellules ganglionnaires du chat ont montré deux types d'unités se distinguant par leur réponse à l'éclairement. Le type X répond d'une façon soutenue, le type Y d'une façon transitoire. Ces unités sont décrites et mises en correlation avec leurs particularités anatomiques et les propriétés fonctionnelles qu'on leur attribue. Les implications de cette classification à l'égard de l'arrangement spatial et temporelle des champs récepteurs sont discutés.

SPECIALIA

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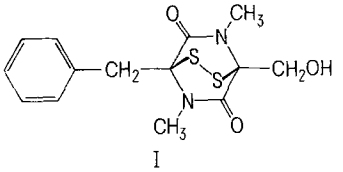
Total Synthesis of (±) Hyalodendrin

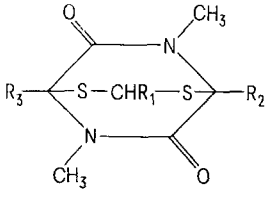
A recent addition to the group of biologically active epidithiodioxopiperazine fungal metabolites[1] is hyalodendrin (I) produced by a *Hyalodendron* sp.[2,3]. Hyalodendrin showed in vitro antimicrobial activity against a broad spectrum of fungi associated with disease in plants and trees, and decay in wood products[2]. Several microorganisms pathogenic to humans were also tested, and found to be sensitive to the antibiotic[2].

In a series of papers published recently, KISHI et al.[4–6] have developed an elegant and versatile strategy for the synthesis of members of this group of compounds, from a piperazine-dione precursor containing an ingeniously protected potential disulfide bridge. The utility of this approach has been amply demonstrated by its application in the synthesis of dehydrogliotoxin[5] and sporidesmin A[6].

We report here the synthesis of racemic hyalodendrin by a short route utilizing the KISHI approach[4].



I



II $R_1 = p\text{-}CH_3OC_6H_4$, $R_2 = R_3 = H$

III $R_1 = p\text{-}CH_3OC_6H_4$, $R_2 = CH_2OCH_3$, $R_3 = H$

IV $R_1 = p\text{-}CH_3OC_6H_4$, $R_2 = CH_2OCH_3$, $R_3 = CH_2C_6H_5$

The monocarbanion, generated from thioacetal II in tetrahydrofuran at $-78°$ by treatment with *n*-butyl lithium ($\sim$ 1 equiv.), reacted as described with chloromethyl methyl ether to give the crystalline alkylated product III[4] in 51% yield (76% based on consumed II). A sample, recrystallized from benzene, had mp 168–170°; mass spectrum: *m/e* 368 (M^+), 184 (base peak) ($M - CH_3O.C_6H_4.CHS_2)^+$.

Alkylation of III with benzyl bromide was effected in a similar manner, giving IV as a colorless oil in 40% yield (54% based on consumed III); mass spectrum: *m/e* 274 ($M - CH_3O.C_6H_4.CHS_2)^+$. (The mass spectrum was very similar to that of IV, prepared as a diastereomeric mixture from hyalodendrin). Racemic IV was oxidized with *m*-chloroperbenzoic acid in methylene chloride at 0° to give a sulfoxide[4] (72% crystalline product, m.p. 135–139°, after preparative layer chromatography). Transformation of the latter to hyalodendrin was best effected in two steps. Thus, the sulfoxide in methylene chloride was treated with a 0.1 *N* solution of perchloric acid in tetrahydrofuran (2 equiv.) at ca. 22° for 24 h. Preparative layer chromatography of the product afforded

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[4] Y. KISHI, T. FUKUYAMA and S. NAKATSUKA, J. Am. chem. Soc. *95*, 6490 (1973).
[5] Y. KISHI, T. FUKUYAMA and S. NAKATSUKA, J. Am. chem. Soc. *95*, 6492 (1973).
[6] Y. KISHI, S. NAKATSUKA, T. FUKUYAMA and M. HAVEL, J. Am. chem. Soc. *95*, 6493 (1973).

racemic hyalodendrin methyl ether (40% of colorless oil) whose identity was established by comparison of IR-, NMR- and mass spectra, as well as TLC behavior with those of an authentic sample. The methyl ether was then cleaved by treatment with boron trichloride in methylene chloride at −70°, affording, after preparative TLC, hyalodendrin (52%) pale yellow crystals from methylene chloride-ether, mp 131–134°, identified by comparison of IR-, NMR-and mass spectra and TLC behavior with those of the natural antibiotic.

Note added in proof. After submission of the manuscript, a report came to our attention describing the isolation of a metabolite with plane structure I, but undetermined absolute configuration, from an unidentified fungus (NRRL 3888) (R. L. DE VAULT and W. ROSENBROOK, J. Antibiot. *26*, 532 [1973]). The enantiomer (3R, 6R) of hyalodendrin, I, has been isolated from *Penicillium turbatum* (K. H. MICHEL, M. O. CHANEY, N. D. JONES, M. M. HOEHN and R. NAGARAJAN, J. Antibiot. *27*, 57 [1974]).

Résumé. L'antibiotique hyalodendrine, produit métabolique d'une espèce d'*Hyalodendron* a été synthétisé en forme racémique utilisant la méthode de KISHI.

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22 February 1974.

Identification of 4-Chloro-4′-hydroxybiphenyl and 4,4′-Dichloro-3-hydroxybiphenyl as Metabolites of 4-Chloro- and 4,4′-Dichlorobiphenyl Fed to Rats

Polychlorinated biphenyls (PCBs) are among the most widespread pollutants in the global environment[1,2]. Recent results have indicated that commercial PCBs (i.e. Aroclor preparations) and individual chlorobiphenyl isomers are susceptible to photolytic degradation with the formation of an array of photoproducts[3–6]. In addition it has also been shown that in a number of plant, animal and microbial systems[7–11] chlorobiphenyl isomers are converted into oxidation products some of which have been tentatively identified as chlorohydroxybiphenyls by mass spectrometric analysis. The present report deals with the elucidation of the precise structure of the hydroxylated metabolites of 4-chlorobiphenyl and 4,4′-dichlorobiphenyl fed to rats.

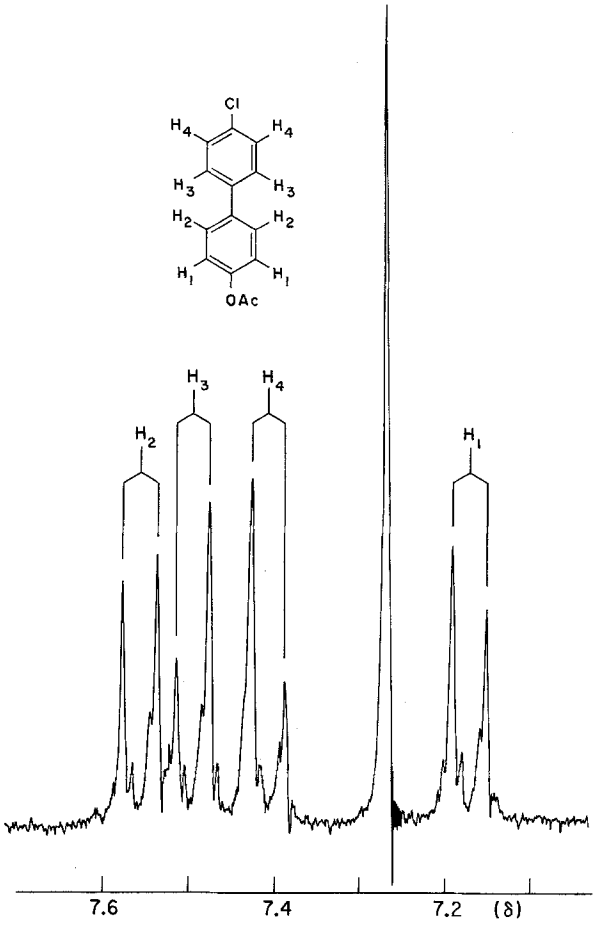

Fig. 1. NMR-spectrum of 4-acetoxy-4′-chlorobiphenyl.

Materials and methods. Male Wistar rats (ca. 75 g body weight) were fed the isomeric chlorobiphenyl (50 mg/kg) by injection of this sample in oil every 24 h for 3 days. Urine and feces were collected for 1 week from the start of the feeding experiments. Urine samples were combined, diluted with an equal volume of 8 *N* sulphuric acid and refluxed for 1 h. The hydrolyzate was extracted with an equal volume of ether (2×) and the combined ethereal extracts dried, concentrated and purified by thin-layer chromatography. The thin-layer bands were assayed by mass spectrometry and those bands containing the chlorohydroxybiphenyl metabolites were treated with acetic anhydride-sodium acetate for 1 h at 100°C. The crude acetate fraction was purified by thin-layer chromatography and the 220 MHz nuclear magnetic resonance (NMR) spectra obtained on the purified acetoxy metab-

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[6] O. HUTZINGER, W. D. JAMIESON, S. SAFE, J. D. MACNEIL and V. ZITKO, *PCB in the Environment* (Marcel Dekker Publishers, New York), in press.
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