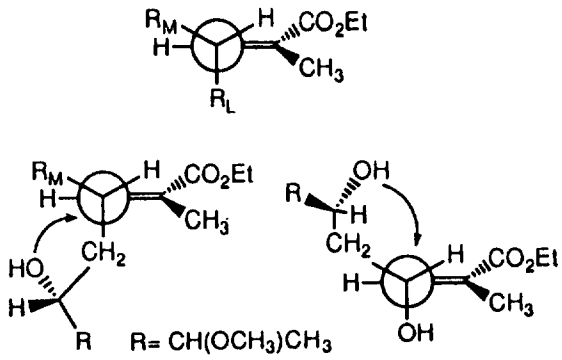

Figure 1.

the stereochemistry at C-4 of α,β-unsaturated esters governs the stereochemical outcome for the formation of tetrahydrofuranyl esters. The rationale was also supported by the fact that even when there was no γ-substitutent for α,β-unsaturated carboxylic ester such as the case for ring closure reaction toward nonactic acid, the predominant product was known to have 2,3-*cis* relationship[7]. Also similar stereochemical result can be found for the intramolecular conjugate addition of carbamate group in the α,β-unsaturated esters[8]. But it is interesting that when we prepared *Z* isomer of **2a** and carried out the cyclization to examine the effect of γ-substituent on stereoselectivity, we had the same stereochemical results as that of *E* isomer of **2a**. On the contrary to the previous report that the stereoselectivity for the conjugate addition of nucleophile to Michael acceptors depends upon *Z/E* configurations of Michael acceptors[9], our results imply that the stereochemical induction for Michael acceptor was insensitive to *Z/E* configurations in our system. Perhaps $A^{1,3}$ strain due to the ester group was almost same as that due to 2-methyl group and thus the steric effect of γ-substituent became dominant in the pocess of stereochemical induction. However, it is still open to the question that the how much the steric effect of α-substituent of *Z/E* isomers can contribute to the stereochemical outcome along with that of competing γ-substituent in the intramolecula Michael reactions leading to tetrahydrofuran rings.

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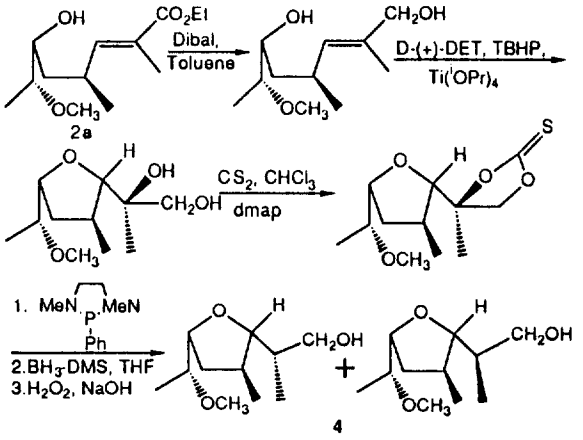

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Synthesis of Specifically Deuterated DNA Hexamer

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The quinoxaline family of antibiotics of which echinomycin is a member are powerful antimicrobial and antitumor agents. The single-crystal X-ray study[1] of a echinomycin complex with d(CGTACG) has shown that, surprisingly, the two central A. T base pairs are of the Hoogsteen type (Figure 1). Two-dimensional NMR studies of echinomycin complexes with d(ACGT) and d(ACGTACGT) duplexes have been reported[2,3]. The van der Waals contacts detected in X-ray crystallographic analysis of are echinomycin-oligonucleotide co-

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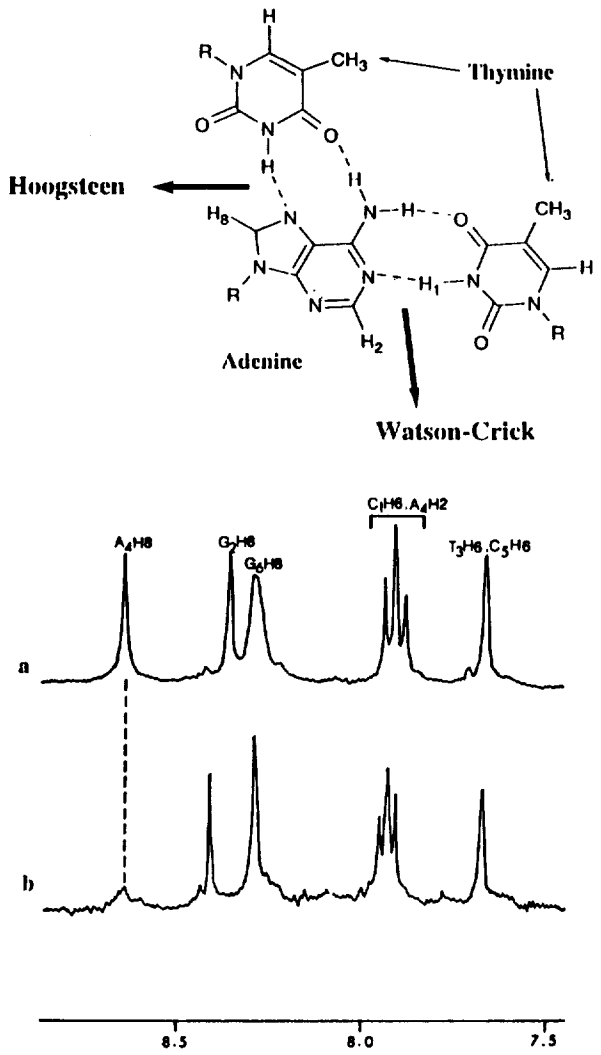
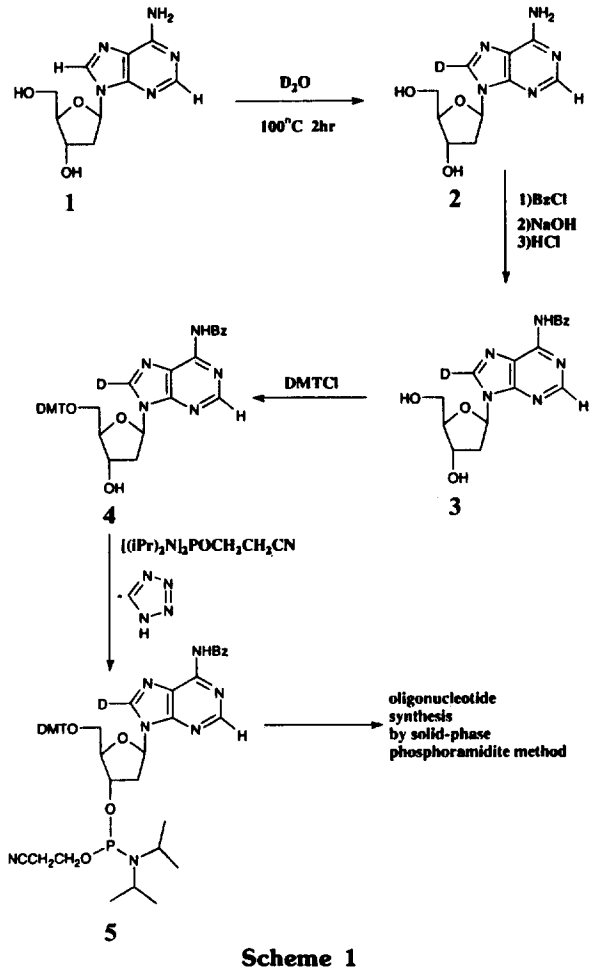


Figure 1. (a) 500 MHz ^{1}H-NMR spectrum of the aromatic proton resonances of the d(CGTACG) duplex obtained in D_2O buffer, pH 7.0, 25℃. Assignments of the some of the DNA resonances are indicated on the figure. (b) Spectrum of DNA hexamer deuterated at the adenine H-8 position; otherwise similar to (a) Dotted line connect resonance position of the adenine H-8 proton. (Inset) Standard A. T and Hoogsteen A. T base pairs. The imino, H-2, and H-8 protons are designated H_1, H_2, and H_8, respectively.



Scheme 1

mplex are retained and the adenosine in the oligonucleotide adopts a syn orientation in solution, which is consistent with the formation of an A. T Hoogsteen base pair.

However, those previous NMR results have not provided definitive discrimination between Watson-Crick and Hoogsteen base pairs due to superposition of quinoxaline protons with the adenosine H-8 and H-2 protons. The present work would like to resolve this ambiguity. Isotopic labeling is the method of choice for NMR identification. Standard A. T base pairs have an adenine H-2 proton adjacent to the imino proton. In contrast, Hoogsteen base pairs have an adenine H-8 proton next to the imino proton (Figure 1). If a NOE from imino proton to carbon proton is observable, then that cabon can be labeled with deuterium in order to identify the NOE mate. Here we report a new synthetic methodology which involves deuterium labeling of the H-8 proton of adenosine in d(CGTACG) duplex.

The strategies for labeling the adenine H-8 position are based on the fact that the proton at this position is labile at high temperature, both for adenine and for purines in nucleic acids[4]. Deoxyadenosine was deuterated as follows: 1 g of it was mixed with 100 g of D_2O and heated to 100℃ for 2 hr in order to label the H-8 position. The mixture was cooled to 5℃ overnight and the precipitate was removed by centrifugation. Deuteration was checked by NMR, and the optical absorption spectrum was unchanged. When the deuterium labeled deoxyadenosine was prepared, the protection of 6-NH_2 and 5'-OH and the phosphitylation of 3'-OH was carried out according to Scheme 1[5].

The protection of the 6-NH_2 of adenine base and the 5'-OH of sugar moiety was achieved by the benzoylation (step 2→3) and dimethoxytritylation (step 3→4), respectively. After phosphitylation, the adenine H-8 deuterated DNA hexamer d(CGTA(D)CG) was synthesized *via* the solid phase phosphoramidite method[6]. NMR spectra of the aromatic region of the unlabeled and labeled DNA hexamer are shown in Figure 1. Assignments of some aromatic resonances are indicated on the spectra. We have found the adenine H-8 proton peak at 8.34 ppm which is definitely missing in the deuterated sample.

In conclusion, this method will provide a clue to clarifying above mentioned ambiguity. We are presently studying the

complex formation between echinomycin and the DNA hexamer using solution NMR.

Acknowledgment. We gratefully acknowledge financial support from Korea Science and Engineering Foundation.

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Photochemistry of 4-Biphenylyl-4-Methyl-2-Cyclohexenone: Solvent Effect on the Excited States

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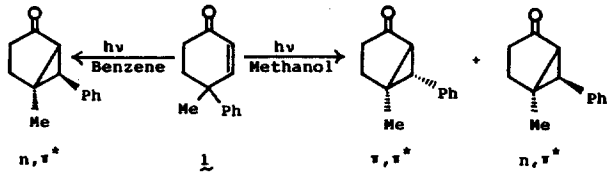
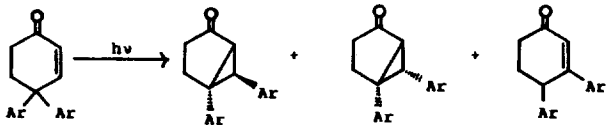
The photochemical rearrangement of 4,4-disubstituted cyclohexenones[1-5] are well known, and mechanism involving solvent effects on the excited states of the enones were proposed in Dauben's earlier publication.[4]

Irradiation of the enone **1** in benzene, a nonpolar solvent, gave product arising from n, π^* triplet state, while in polar solvent such as methanol gave the product arising from the both of n, π^* and π, π^* triplet state.



Recently Zimmerman[1,2] and his co-workers investigated the photochemical behavior of bichromophoric excited states of 4,4-dibiphenylylcyclohex-2-enone (**2**)



2 : Ar = Biphenylyl 3 : Ar = Phenyl

Table 1. Product Distribution on Irradiation of **4** in Different Solvent Polarity

Solvent	Φ			Relative Amounts (%)	
	4	**5**	**6**	**5**	**6**
Benzene	[a]	[a]	[a]	98	~2
Methanol	0.0070	0.0033	0.0007	82	18

Φ: quantum efficienty. [a] not determined[10].

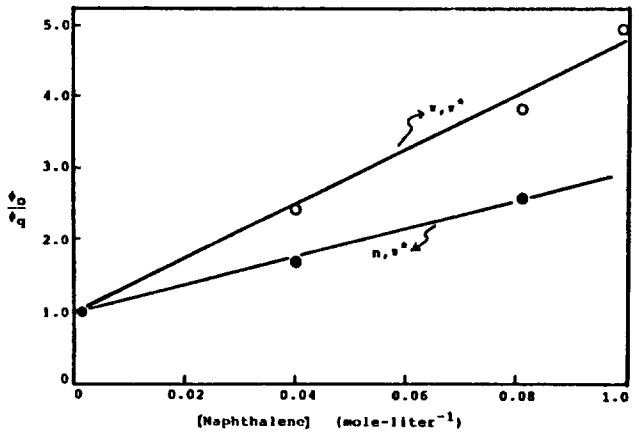
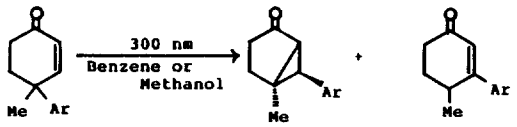


Figure 1. Stern-Volmer plot of triplet quenching of formation of **5** (●) and **6** (○) in methanol.

Since biphenylyl groups on the C-4 position of the enone moiety produce the same type of photoproducts as 4,4-diphenylcyclohexenone (**3**) photochemistry[11], 4-biphenylyl-4-methyl-2-cyclohexenone (**4**) was synthesized and the solvent effect on the excited state of the enone **4** involving the relative energy levels of n, π^* and π, π^* triplet states was investigated.

Direct irradiation of the enone **4** in benzene with 16 RPR-3000 Å lamps produced *trans*-5-methyl-6-biphenylylbicyclo [3.1.0]hexan-2-one[6] (**5**) and 3-biphenylyl-4-methylcyclohex-2-enone (**6**) in trace.



Ar = Biphenylyl

When polar solvent such as methanol was used for irradiation of **4**, relative amount of the product[7] **6** was increased as shown in Table 1.

Sensitized irradiation of the enone **4** with acetophenone produced the products as direct irradiation with the same product ratios.

Stern-Volmer type analysis for the products **5** and **6**, products possibly representative of the reactions from different triplet states, were undertaken in methanol using naphthalene (E_T=91 Kcal) as a quencher.

The results are shown in Figure 1 and the differnce observed in the slopes for the quenching is indicative of the involvement of two excited states of different lifetimes[4,8,9].