A Convenient Synthesis of 4- and 5-Acetyltropolone

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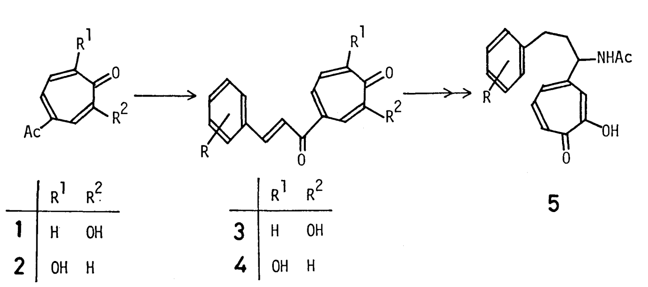
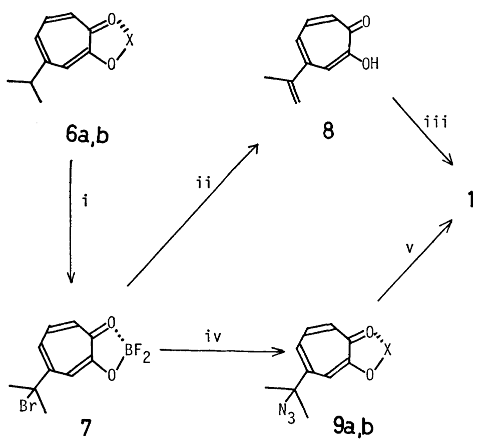
4-Acetyltropolone is derived from hinokitiol (β-thujaplicin) in four steps, with an overall yield of 60%, *via* readily available 8-azidohinokitiol. γ-Thujaplicin almost quantitatively forms its difluoroboron complex, which, upon bromination, provides an 85% yield of the 8-bromo-γ-thujaplicin difluoroboron complex. This bromo compound readily gives γ-dolabrin (87% with triethylamine) and 8-azido-γ-thujaplicin (88% with sodium azide), from which 5-acetyltropolone is derived in an 80% yield by ozonolysis or in a 40% yield with sulfuric acid. The considerable differences in the reactivities observed between these 4- and 5-substituted tropolones are discussed. The pK_a values of 4- and 5-acetyltropolone and 4- and 5-(3,4,5-trimethoxycinnamoyl)tropolones are also reported.

The tropolone nucleus is well known to be susceptible to many electrophilic substitution reactions, but does not undergo the Friedel-Crafts-type alkylation or acylation.[1-4] Several examples of direct carbon-carbon bond formation on the tropolone nucleus by various methods under basic conditions (*e.g.*, the Reimer-Tiemann reaction, hydroxymethylation, and the Mannich reaction) have been reported. These reactions, however, have drawbacks either with respect to the preparative yield or the regioselective control.[1-5] Organometallic reagents, such as Grignard or lithium reagents, give rise to the alkyl- or aryl-substitution products only at the 2-position of the tropolone nucleus.[1] Therefore, one of the present authors (T.N.) and his co-workers utilized naturally occurring β-dolabrin[6] (**8**) or 3-carboxy-4-carboxymethyltropolone derived from natural purpurogallin[1-3] as the starting material in preparing tropolones bearing a *C*-substituent at the 4-position.[7] For example, **8** was oxidatively converted[6b] into 4-acetyltropolone (**1**), which subsequently afforded a wide variety of the cinnamoyltropolones (**3**) and their derivatives (**5**) for the attempted synthesis of colchicine analogs,[1,8] although the detailed experimental results have remained unpublished[7] (Scheme 1). 5-Acetyltropolone (**2**) was also derived from **8** by a multi-step conversion in a 10—15% overall yield and likewise afforded the 5-cinnamoyltropolones[9] (**4**).



Scheme 1.

Renewed interest in the pharmacology of colchicine, particularly concerning the binding sites of the microtuburins in the muscle and nerve cells,[8] led us to reinvestigate our old synthetic scheme involving **3** or **4** as an intermediate. However, the extremely limited supply of the natural β-dolabrin necessitated a search for an alternative, efficient method of preparing two acetyltropolones, **1** and **2**. Although two practically valuable methods have been reported recently for the preparation of **8** starting from tropone-tricarbonyliron[4] or quinone monoacetals,[8a] the conversion of hinokitiol[1] (**6a**) and γ-thujaplicin[10] (**10a**) into **1** and **2** appeared to be more preparative value, since these isopropyltropolones are easily available from an isopropylcyclopentadiene–dichloroketene adduct by applying the Stevens method.[11,12] We wish to describe herein the effective synthesis of two acetyltropolones **1** and **2** as the initial part of a reinvestigation of the synthesis of various 4- and 5-substituted tropolones including colchicine analogs.



Scheme 2. a: X=H, b: X=BF_2. Reagents: i, Ref. 13; ii, n-$Bu_4N^+Br^-$–0.5 M NaOH–CH_2Cl_2; iii, Ref. 6b, 16; iv, NaN_3; v, H_2SO_4.

Seto *et al.*[13] reported an efficient conversion of **6a** into the bromo compound (**7**), which in turn was dehydrobrominated to afford a 30% yield of **8** (Scheme 2). Since the above elimination reaction with potassium *t*-butoxide in *t*-butyl alcohol failed to produce **8** in our experiment, we examined the conversion of **7** to **8** using various other bases, such as triethylamine in chloroform, 1,8-diazabicyclo[5.4.0]undec-7-ene (DBU) in DMF, or 0.5 mol dm^{-3} sodium hydroxide–dichloromethane with tetrabutylammonium bromide as a phase-transfer catalyst. Among these, only the last procedure afforded a 20—25% yield of **8**; the major products under these conditions were an intractable, polymerized substance and 8-hydroxyhinoki-

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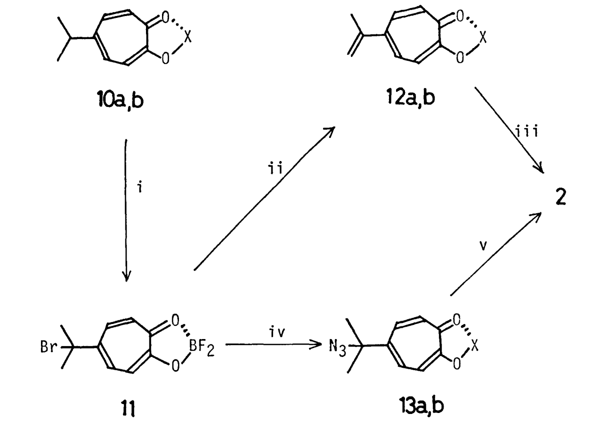
Table 1. Ionization constants and UV spectra[a)]

Compd	Species[c)]	Ionization in water (25 °C)			Spectroscopy[b)] in water		
		pK_a	Concn/M	A.w.l.[d)]	λ_{max}/nm	log ε	pH
1	0				251, 318, 382	4.50, 3.75, 3.76	1.0
	—	6.23±0.06	3.09×10^{-5}	436	267, 344, 436	4.33, 4.02, 3.77	9.1
2	0				226, 257, 342	4.57, 4.39, 4.34	1.0
	—	4.97±0.05	1.43×10^{-5}	389	237, 270, 389	4.59, 4.00, 4.66	9.1
3[e)]	0				255, 342	4.41, 4.31	MeOH[f)]
	0				254, *340*, 370	4.34, *4.14*, 4.15	1.0
	—	6.08±0.07	1.19×10^{-5}	348	222, 262, *275*, 348, *425*	4.27, 4.16, *4.14*, 4.34, *3.60*	9.1
4[e)]	0				228, 259, 358	4.47, 4.23, 4.32	1.0
	—	4.85±0.06	1.19×10^{-5}	425	230, *240*, *272*, *388*, 425	4.50, *4.43*, *4.03*, *4.33*, 4.51	9.1

a) Measured with a Hitachi EPS 3T Recording Spectrophotometer. b) Inflections in italics. c) Neutral species (0) and monoanion (−). d) Analytical wavelength in nm (*cf.* Ref. 19). e) R=3,4,5-(MeO)$_3$ (*cf.* Refs. 1, 7, 9). f) From Ref. 7c.

tiol.[14)] Because of the fluctuation in the yield and the difficulties in optimizing the conditions of the above reaction, we sought for a more reliable alternative route to 4-acetyltropolone (**1**).

Thus, the treatment of **7** with 1.3 equivalent sodium azide in DMF produced an 85% yield of the boron complex (**9b**), which in turn was directly transformed into **1** (82%) with concd sulfuric acid, apparently by means of a Schmidt reaction[15)] (Scheme 2). The structure of the hitherto unreported intermediate, **9b**, was based on the elementary analysis and the spectroscopic data (see Experimental section). The mild alkaline hydrolysis of **9b** readily afforded crystalline 8-azidohinokitiol (**9a**; 88% yield), which had been postulated by Doi[16)] as an intermediate during the conversion of **8** into **1** with hydrazoic acid. The free tropolone (**9a**) indeed produced **1** in an 80% yield when similarly subjected to the Schmidt reaction. The overall yield of **1** from **6a** (*via* **9b**) was *ca.* 60%, which far exceeds that obtained through the formerly employed route *via* **8** (10—15%).[6b,16)]



Scheme 3. a: X=H, b: X=BF$_2$. Reagents: i, BF$_3$·OEt$_2$; ii, Et$_3$N; iii, O$_3$-Me$_2$S; iv, NaN$_3$; v, H$_2$SO$_4$.

This convenient synthetic method of preparing **1** led us to examine an analogous approach in preparing 5-acetyltropolone (**2**) (Scheme 3). Thus, γ-thujaplicin (**10a**) was almost quantitatively converted into its difluoroboron complex (**10b**), and then into the 8-bromo derivative (**11**) in an 85% yield, by employing a slight modification of the procedure described above. Compound **11** was found to undergo surprisingly facile dehydrobromination with triethylamine in chloroform at 15 °C to furnish γ-dolabrin (**12a**) in an 85% overall yield after the hydrolysis of the intermediate boron complex (**12b**). This was in striking contrast with the results for its β-isomer (**7**), which gave mostly a polymerized product and 8-hydroxyhinokitiol. Since **12a** had been prepared[9)] either from the octyl ester of 5-carboxytropolone (7% overall) or β-dolabrin (**8**) by a three-step conversion (15%), the above method is obviously of some value for preparing **12a**.

Although 5-acetyltropolone (**2**) was obtained from **12a** through oxidative cleavage (60—70% overall yield with HCO$_3$H, NaOH, and HIO$_4$),[9)] the ozonolysis of **12a** at −70 °C was found to provide **2** more conveniently in an 80—85% yield. Alternatively, a similar application of the Schmidt reaction on either 8-azido-γ-thujaplicin (**13a**) or its difluoroboron complex (**13b**), both of which are readily available from **11**, as in the case of the β-isomer, produced only a moderate yield (40%) of 5-acetyltropolone (**2**), together with a minor amount of 5-aminotropolone.[17)] This result was again different from that for the β-isomer (**9a,b**), which prodived **1** exclusively. 5-Acetyltropolone (**2**) was thus found to be synthesized from γ-thujaplicin (**10a**) more satisfactorily through γ-dolabrin (**12a**) in an overall yield of 70%.

Scheme 4. X=Br, N$_3$.

Considerable differences in various reactivities were observed between the 4- and 5-positions in the tropolone nucleus. The extremely facile dehydrobromination in **11** and the increased migratory aptitude of tropolone ring in **13** to produce a considerable amount of 5-aminotropolone could be explained in terms of a very limited contribution of a polar resonance form **14** to the actual ground state of the 5-substituted tropolones (**11** and **13**) compared with that of **15** to the 4-substituted tropolones **7** and **9b** (Scheme 4). On the other hand, the presence of an appreciable cationic charge at Position 4, as is shown in **15**, would suppress the elimination reaction in **7** and promote the polymerization of the side-chain of the β-dolabrin difluoroboron complex formed. Formula **15** is also compatible with the suppressed migratory aptitude of the tropolone nucleus in the Schmidt reaction of **9**. However, a closer mechanistic study with regard to these interesting differences is currently in progress.

A significant positional difference was also observed in the pK_a values of 4- and 5-acetyltropolone and the readily obtainable 4- and 5-(3,4,5-trimethoxycinnamoyl)tropolones [**3**,**4**; R=3,4,5-(MeO_3)]; these hitherto unreported values are recorded in Table 1, along with their UV-spectral values in aqueous buffers. The pK_a value of **2** fits this relation:

$$pK_a = 6.42 - 3.10\sigma$$

if the σ_p constant for phenol is used (predicted: 4.8).[18] These values, therefore, appear to be in conformity with the generally observed feature that Positions 4 and 5 in tropolones are approximately to be equated with Positions 3 and 4 in phenols.

The 4- and 5-acetyltropolone (**1** and **2**), thus synthesized easily from the readily available starting materials, **6a** and **10a**, are considered to be valuable intermediates in synthesizing various 4- and 5-substituted troponoids, including colchicine analogs, which are under investigation.

Experimental

The ^1H-NMR spectra were measured in $CDCl_3$ with a Hitachi High-resolution NMR Spectrometer, R-20A (60 MHz) at 30 °C. The chemical shifts are reported as δ values in ppm relative to TMS (δ 0.0) as the internal standard. The IR spectra were taken with a Nihon-Bunko IR-S spectrometer. The microanalysis was carried out in this department using a Yanagimoto CHN Corder, MT-2. Substances stated to be identical were compared by means of their IR and ^1H-NMR spectra, TLC (silica gel), HPLC (Hitachi gel #3011, with 0.1% AcOH/MeOH as a solvent), and paper chromatography (developed in 7:3 *n*-BuOH/5 M (1 M=1 mol dm^{-3}) AcOH or 2:1 *n*-PrOH/1% aq ammonia).

*Difluoro(3-isopropyl-7-oxo-1,3,5-cycloheptatrienyloxy)borane (Hinokitiol Difluoroborane; **6b**).* The procedure of Seto *et al.*[13] was followed, but on a much larger scale, using an overhead mechanical stirrer, a three-necked flask fitted with a dropping funnel, and a condenser. Thus, 18.0 g (0.11 mol) of **6a** and 15.6 g (0.11 mol) of freshly distilled boron trifluoride etherate gave 22.2 g (96%) of the difluoroborane (**6b**) after recrystallization from chloroform–benzene (*ca.* (4:7); mp 171—172 °C (lit,[13] 178—179 °C). Further purification by silica-gel chromatography with 5% AcOEt/C_6H_6 and recrystallization did not raise the melting point. NMR 1.37 (6H, d, J=7.0), 3.20 (1H, sept, J=7.0), and 7.35—8.1 (4H, m).

*[3-(1-Bromo-1-methylethyl)-7-oxo-1,3,5-cycloheptatrienyloxy]difluoroborane (8-Bromohinokitiol Difluoroborane; **7**).* This material was also prepared according to the procedure of Seto *et al.*,[13] but on a larger scale and with a slight modification. Thus, 15.0 g (0.094 mol) of freshly distilled bromine was slowly added to a refluxing solution of 15.0 g (0.071 mol) of **6b** dissolved in 150 ml of dry chloroform under a tungsten light with mechanical stirring. The mixture was refluxed for 6 h with stirring, with protection against moisture being provided by a $CaCl_2$ tube. The precipitate was filtered off and washed with chloroform, giving 18.3 g (89%) of **7**; mp 176—180 °C dec (from $CHCl_3$) (lit,[13] 188—189 °C). NMR (DMSO-d_6/$CDCl_3$, 1:2) 2.30 (6H, s) and 7.8—8.4 (4H, m).

*4-Isopropenyl-2-hydroxy-2,4,6-cycloheptatrien-1-one (β-Dolabrin; **8**).* A suspension of 0.29 g (1.0 mmol) of **7** in 20 ml of dichloromethane was added at 40 °C to a stirred mixture of 20 ml of 0.5 mol dm^{-3} NaOH and 5 ml of CH_2Cl_2 containing 70 mg (0.21 mmol) of tetrabutylammonium bromide over a period of 50 min; then the mixture was stirred under N_2 at 40—45 °C for 12 h. After separation, the aq layer was washed with CH_2Cl_2, carefully brought to pH 3 at 5 °C with 6 mol dm^{-3} HCl, and extracted with CH_2Cl_2. The dried (over Na_2SO_4) extracts were evaporated *in vacuo*, and the residue was flash-distilled at 85 °C (bath)/7 Torr (1 Torr≈133.322 Pa), giving 40 mg (25%) of **8** as a pale yellow liquid which slowly solidified on standing and which was identical with an authentic specimen. No appreciable amount of **8** was obtained when other bases were used *e.g.*, triethylamine in chloroform (50 °C, 6 h; 60% recovery, 15% of 8-hydroxyhinokitiol), *t*-BuOK/*t*-BuOH[13] (10—20 °C, 1.5 h; 30% recovery of **7**, 10% of 8-hydroxyhinokitiol, and 5% of **8**), DBU/DMF (0 °C, 1.5 h; 40% of **7**, 10% of 8-hydroxyhinokitiol). In all cases, the residue was an intractable gummy substance, apparently a polymerized product.

*[3-(1-Azido-1-methylethyl)-7-oxo-1,3,5-cycloheptatrienyloxy]difluoroborane (8-Azidohinokitiol Difluoroborane; **9b**).* A solution of 4.11 g (14.1 mmol) of **7** and 1.18 g (18.2 mmol) of sodium azide in 40 ml of dry DMF was stirred under N_2 at 15 °C for 15 h. The solvent was then removed *in vacuo* (pump), and the residue, diluted with water, was extracted with benzene. The combined extracts were dried over Na_2SO_4 and evaporated *in vacuo*. The residue was purified by passing it through a short column of silica gel with 5% AcOEt–C_6H_6, thus affording 3.04 g (85%) of **9b** as colorless crystals; mp 71—73 °C (from benzene–light petroleum). NMR 1.74 (6H, s, $2CH_3$-8) and 7.6—8.2 (4H, m, aromatic). IR ($CHCl_3$) 2150 (N_3) and 1615 cm^{-1} (C=O). Found: C, 47.25; H, 4.11; N, 16.49%. Calcd for $C_{10}H_{10}N_3O_2BF_2$: C, 47.47; H, 3.98; N, 16.61%.

*4-(1-Azido-1-methylethyl)-2-hydroxy-2,4,6-cycloheptatrien-1-one (8-Azidohinokitiol; **9a**).* A mixture of 46 mg of **9b**, 2 ml of *t*-butyl alcohol, and 2 ml of 1 mol dm^{-3} KOH was stirred at 20 °C for 5 h. The alcohol was then removed *in vacuo*, and the remaining aq layer was taken to pH 4 with 2 mol dm^{-3} HCl at 5 °C and extracted with CH_2Cl_2. The combined organic layers were dried over Na_2SO_4 and evaporated *in vacuo*, giving 33 mg (88%) of **9a** as colorless prisms (from ether–light petroleum); mp 45—46 °C. NMR 1.68 (6H, s, $2CH_3$-8), 7.2—7.45 (3H, m, H-5,6,7), 7.56 (1H, bs, H-3), and 8.0 (1H, bm, HO-2, D_2O exchangeable). IR ($CHCl_3$) 3450 (OH), 2150 (N_3), and 1610 cm^{-1} (C=O). Found: C, 58.65; H, 5.62; N, 20.15%. Calcd for $C_{10}H_{11}N_3O_2$: C, 58.53; H, 5.40; N, 20.48%.

*4-Acetyl-2-hydroxy-2,4,6-cycloheptatrien-1-one (4-Acetyltropolone; **1**).* Three milliliters of concd sulfuric acid were added dropwise to a solution of 3.84 g (15.2 mmol) of **9b** in 6 ml of chloroform at 0 °C; the mixture was then stirred at 0 °C for 15 min and at 20 °C for 2 h. After the $CHCl_3$ layer had then been removed, the acid layer was diluted with 15 ml of cold water, brought to pH 3 by adding solid $NaHCO_3$, and extracted with $CHCl_3$. The combined extracts were dried over Na_2SO_4 and evaporated *in vacuo*, giving 2.04 g (82%) of **1** as yellow crystals; mp 125—127 °C (from 70% aq ethanol). The product was identical with an authentic specimen[6] (mp 129 °C). 8-Azidohinokitiol (**9a**) produced **1** in 80% and 64% yields when similarly treated with concd sulfuric acid and polyphosphoric acid (at 55 °C) respectively.

*Difluoro(4-isopropyl-7-oxo-1,3,5-cycloheptatrienyloxy)borane (γ-Thujaplicin Difluoroborane; **10b**).* The procedure for the β-isomer was followed. Thus, 5.3 g (31 mmol) of trifluoroboron etherate, dissolved in 10 ml of dry ether, was added dropwise to a solution of 4.59 g (28 mmol) of **10a** in 80 ml of dry ether–benzene (1:1) at 5 °C over a period of 1 h with stirring under the protection of a $CaCl_2$ tube. After being stirred at 5 °C for 4 h, the mixture was concentrated *in vacuo*, and the residue was recrystallized from benzene/light petroleum to give 5.05 g of **10b** as white needles; mp 104—105 °C. The filtrate was concentrated *in vacuo*, and the residue was chromatographed over silica gel with 5% ether–benzene, thus affording 0.50 g more of **10b**; mp 103 °C (from the same mixed solvent); thus, the combined yield of **10b** was 5.55 g (94%). NMR 1.35 (6H, d, J=6.5, $2CH_3$-8), 2.13 (1H, sept, J=6.5, H-8), 7.75 (2H, d, J=11, H-2,6), and 8.00 (2H, d, J=11, H-3,5). Found (for material dried at 40 °C/15 Torr): C, 56.43; H, 5.11%. Calcd fcr $C_{10}N_{11}O_2BF_2$: C, 56.60; H, 5.18%.

*[4-(1-Bromo-1-methylethyl)-7-oxo-1,3,5-cycloheptatrienyloxy]difluoroborane (8-Bromo-γ-thujaplicin Difluoroborane; **11**).* To a stirred suspension of 6.78 g (32 mmol) of **10b** in 250 ml of dry CCl_4 was added dropwise 5.2 g (32.5 mmol) of bromine dissolved in 20 ml of dry CCl_4 at 20 °C over a period of 90 min under a tungsten light and a slow stream of N_2; the mixture was subsequently stirred at room temperature for 4 h. The precipitate was filtered off and washed with CCl_4, thus giving 7.82 g (85%) of **11** as colorless crystals; mp 116—119 °C. Recrystallization from benzene–light petroleum raised the melting point to 119—120 °C. A lesser yield of **11** was obtained when chloroform was used as the solvent or when the reaction mixture was refluxed. NMR 2.28 (6H, s, $2CH_3$-8), 7.81 (2H, d, J=12, H-2,6), and 8.51 (2H, d, J=12, H-3,5). Found: C, 41.01; H, 3.25%. Calcd for $C_{10}H_{10}O_2BrBF_2$: C, 41.24; H, 3.42%.

*Difluoro(4-isopropenyl-7-oxo-1,3,5-cycloheptatrienyloxy)borane (γ-Dolabrin Difluoroborane: **12b**).* To a solution of 200 mg (0.69 mmol) of **11** in 3 ml of dry CH_2Cl_2 was added 73 mg (1.37 mmol) of triethylamine under N_2 at 0 °C. The mixture was stirred at 15 °C for 7 h, and then a 3-ml portion of cold water was added. After separation, the aq layer was extracted with CH_2Cl_2. The combined organic layers were dried over Na_2SO_4 and evaporated *in vacuo*, thus giving 130 mg (90%) of **12b** as colorless needles; mp 148—149 °C (from benzene–light petroleum). NMR 2.26 (3H, bs, CH_3-8), 5.40 (2H, bs, CH_2=C-8), 7.84 (2H, d, J=12, H-2,6), and 8.17 (2H, d, J=12, H-3,5). Found: C, 57.51; H, 4.48%. Calcd. for $C_{10}H_9O_2BF_2$: C, 57.17; H, 4.76%.

*5-Isopropenyl-2-hydroxy-2,4,6-cycloheptatrien-1-one (γ-Dolabrin; **12a**).* A mixture of 4.40 g (15 mmol) of **11** and 3.50 g (35 mmol) of triethylamine in 60 ml of dry $CHCl_3$ was stirred under N_2 at 20 °C for 3 h and then concentrated *in vacuo*. The residue was stirred with a mixture of 50 ml of *t*-butyl alcohol and 260 ml of 1.3 mol dm^{-3} KOH at 20 °C for 30 min. The alcohol was removed *in vacuo*, and the residue was carefully taken to pH 3 with 2 mol dm^{-3} HCl at 5 °C. The precipitate was filtered off and washed with water, thus giving 1.88 g of **12a** as pale yellow crystals; mp 98—100 °C (lit,[9] 100—101 °C). From the filtrate, 0.25 g more of **12a** was obtained after extraction with $CHCl_3$, sublimation at 80 °C/0.01 Torr, and recrystallization from cyclohexane; thus, the total yield of **12a** from **11** was 2.13 g (87%). NMR 2.15 (3H, bs, CH_3-8), 5.20 and 5.28 (1H, each, m, CH_2=C-8), 7.33 (2H, d, J=11, H-3,7), 7.49 (2H, d, J=11, H-4,6), and 7.80 (1H, bs, HO-2, D_2O exchangeable). The product was identical with an authentic specimen.[9]

*[4-(1-Azido-1-methylethyl)-7-oxo-1,3,5-cycloheptatrienyloxy]difluoroborane (**13b**) and 8-Azido-γ-thujaplicin (**13a**).* A mixture of 20 mg (0.069 mmol) of **11** and 6 mg (0.092 mmol) of sodium azide in 0.5 ml of dry DMF was stirred under N_2 at 50 °C for 1.5 h. The solvent was then evaporated at 20 °C/0.3 Torr. The residue was dissolved in benzene, washed with water, dried over Na_2SO_4, and evaporated *in vacuo*, thus giving 10 mg (57%) of **13b** as pale yellow needles; mp 81—83 °C (from ether–light petroleum). NMR 1.75 (6H, s, $2CH_3$-8), 7.86 (2H, d, J=12, H-2,6), and 8.32 (2H, d, J=12, H-3,5). IR ($CHCl_3$) 2150 (N_3) and 1615 cm^{-1} (C=O). Found: C, 47.25; H, 4.16; N, 16.32%. Calcd for $C_{10}H_{10}N_3O_2BF_2$: C, 47.47; H, 3.98; N, 16.61%.

When the reaction was carried out using 116 mg of **11** at 20 °C for 16 h, 89 mg (88%) of a *ca.* 2:1 mixture of **13b** and **13a** (see below) were produced as an amber liquid.

A mixture of 17 mg (0.066 mmol) of **13b**, 1 ml of 1 mol dm^{-3} KOH, and 1 ml of *t*-BuOH was stirred under N_2 at 20 °C for 3 h. The alcohol was then removed *in vacuo*, and the remaining aq solution was taken to pH 4 with 2 mol dm^{-3} HCl and extracted with $CHCl_3$, thus giving 11 mg (80%) of **13a** as a pale amber oil. NMR 1.58 (6H, s, $2CH_3$-8), 7.30 (2H, d, J=12, H-3,7), 7.64 (2H, d, J=12, H-4,6), and 7.7 (1H, bm, OH). IR ($CHCl_3$) 3450 (OH), 2150 (N_3), and 1610 cm^{-1} (C=O).

*5-Acetyl-2-hydroxy-2,4,6-cycloheptatrien-1-one (5-Acetyltropolone; **2**).* *A)*: Into a stirred solution of 0.50 g (3.9 mmol) of **12a** in 50 ml of dry CH_2Cl_2 was passed 42 mg (8.5 mmol) of ozone at −70 °C over a period of 1 h; then 0.6 ml of dimethyl sulfide was added. The mixture was gradually warmed, and the stirring was continued at 15 °C for 3 h. The solvent was evaporated *in vacuo*, and the residue, diluted with brine, was extracted with $CHCl_3$, thus giving 0.43 g (85%) of **2** as pale yellow crystals after recrystallization from $CHCl_3$–ethanol (with carbon); mp 179—181 °C (lit,[9] 182—183 °C). NMR 2.63 (3H, s, Ac), 6.1 (1H, bs, OH, D_2O exchangeable), 7.37 (2H, d, J=12, H-3,7), and 8.11 (2H, d, J=12, H-4,6). The product was identical with an authentic specimen.[9]

B): To a cold solution of 36 mg of crude **13b** in 1.5 ml of $CHCl_3$ was added 1.5 ml of concd sulfuric acid at 0 °C. The mixture was stirred at 20 °C for 1 h, after which the organic layer was separated. The aq layer was diluted with 4 ml of cold water, taken to pH 3 with $NaHCO_3$, and extracted with $CHCl_3$, thus giving 10 mg (40%) of **2** as pale yellow crysals; mp 175—178 °C (from $CHCl_3$–EtOH). The above aq layer (after $CHCl_3$ extraction at pH 3) was found to contain 5-aminotropolone (by HPLC and paper chromatography), which was subsequently isolated and identified as the picrate: yellow crystals, mp 220—225 °C dec (lit,[17] 225—226 °C dec). Almost the same result was obtained by using **13a** as the starting material or by employing polyphosphoric acid as the reaction medium.

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