Tetrahedron Letters,Vol.26,No.10,pp 1319-1320,1985	0040-4039/85 $3.00 + .00
Printed in Great Britain

SYNTHESIS OF HEPIALONE; PRINCIPAL COMPONENT FROM MALE SEX SCALES OF HEPIALUS CALIFORNICUS (LEPIDOPTERA)

Keiso Uchino, Yoshiro Yamagiwa and Tadao Kamikawa*
Department of Chemistry, Faculty of Science and Technology,
Kinki University, Kowakae, Higashi-Osaka 577, Japan

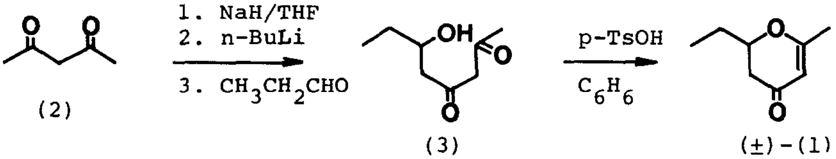
Isao Kubo
Division of Entomology and Parasitology, College of Natural Resources,
University of California, Berkeley, CA 94720, USA

Abstract: Racemic and optically active hepialone, a new sex-pheromonal component produced by the male moth, *Hepialus californicus* Bvd., was synthesized and thus confirmed the structure of the pheromone as (2R)-2,3-dihydro-2-ethyl-6-methyl-4H-pyran-4-one (1).

In a previous paper[1], one of us (I. K.) reported the isolation and structure of hepialone (1), a principal sex-pheromone produced by the male moth, *Hepialus californicus* Bvd. In order to understand the strange sexual behaviour of the moth and to confirm the structure of the pheromone, we began to synthesize (1).

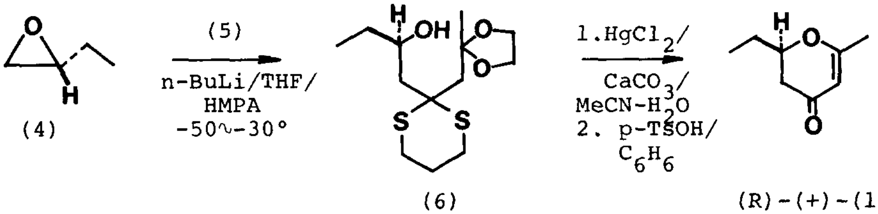
Synthesis of the racemic (1) was accomplished by aldol reaction followed by cyclization (Scheme 1). Treatment of propionaldehyde with the dianion of 2,4-pentanedione gave a mixture of aldols (3), which, without further purification, were treated with p-toluenesulfonic acid to give racemic (1) in 31% overall yield. The IR, ^{1}H-NMR and ^{13}C-NMR spectra were identical with those of the natural pheromone[2].

(Scheme 1)



Synthesis of natural (+)-hepialone was accomplished as shown in Scheme 2.

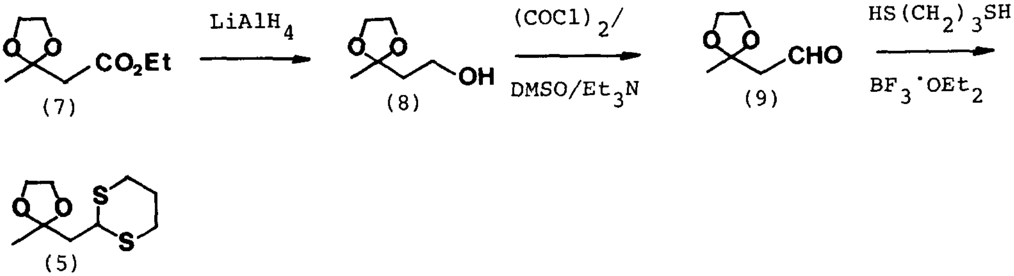
(Scheme 2)



(R)-1,2-Epoxybutane (4), $[\alpha]_D^{20}$ +22.2° (c=0.37, EtOH), [lit[3]. $[\alpha]_D^{16}$ +12.4° (dioxane)], which was prepared from *d*-malic acid according to the method of Seebach[3], was treated with the carbanion derived from (5) at -50 to -30°C to give dithianyl alcohol (6) in 51% yield after chromatography (SiO_2; 9:1 C_6H_6-AcOEt as eluent). Deprotection of (6) with mercuric chloride followed by acid cyclization gave optically active hepialone (1), $[\alpha]_D^{20}$ +106.4° (c= 1.09, EtOH), in 46% yield after distillation. The synthetic product was identical with the natural pheromone in all respects[4], thus confirming the absolute configuration.

Masked 3-oxobutanal (5) was prepared from 2-carbethoxymethyl-2-methyl-1,3-dioxolane (7) by the following reaction sequence; i) reduction with LAH (8; 81%), ii) oxidation by Swern's procedure[5] (9; 76%) and thioacetalization (5; 49%).

(Scheme 3)



References and notes

1. I. Kubo, T. Matsumoto, D.L. Wagner and J.N. Shoolery, *Tetrahedron Lett.*, in press.
2. Racemic (1); bp 116-120°/25mmHg; IR(neat) 1670, 1615, 1000, 890 and 815 cm^{-1}; ^1H-NMR($CDCl_3$, 200MHz) δ1.03(t, 3H), 1.8(m, 2H), 1.97(s, 3H), 2.2 (m, 2H), 4.32(m, 1H) and 5.33(s, 1H); ^{13}C-NMR($CDCl_3$, 59.25MHz) δ 9.2(q), 21.0(q), 27.5(t), 80.4(d), 104.7(d), 174.2(s) and 192.8(s); EI-MS m/e 140(M^+) and 85(base peak).
3. B. Seuring and D. Seebach, *Helv. Chim. Acta*, 60, 1175(1977).
4. Optically active (1); bp 130-140°(oven temp)/7mmHg; UV λ_{max} 262nm (ε 12,300, EtOH); IR and ^1H-NMR spectra were identical with those of the racemic (1); Anal calcd for $C_8H_{12}O_2$: C, 68.54; H, 8.63. Found: C, 68.48; H, 8.68.
5. K. Omura and D. Swern, *Tetrahedron*, 34, 1651(1978).

(Received in Japan 1 December 1984)