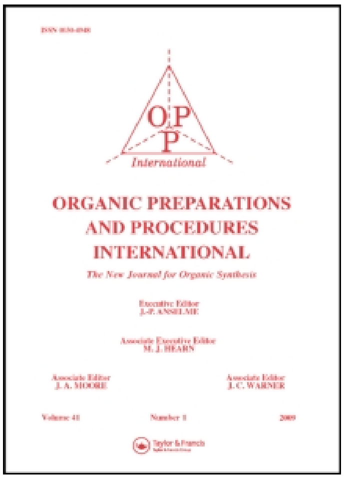


Organic Preparations and Procedures International
Publication details, including instructions for authors and subscription information:
http://www.informaworld.com/smpp/title~content=t902189982

A SYNTHESIS OF (±)-3-ACETOXY-2,6-DIMETHYL-1,5-HEPTADIENE, THE SEX PHEROMONE OF THE COMSTOCK MEALYBUG

Suk-Ku Kang[a]; Choong-Sil Park[a]
[a] Department of Chemistry, Sung Kyun Kwan University, Natural Science Campus, Suwon, KOREA

To cite this Article Kang, Suk-Ku and Park, Choong-Sil(1990) 'A SYNTHESIS OF (±)-3-ACETOXY-2,6-DIMETHYL-1,5-HEPTADIENE, THE SEX PHEROMONE OF THE COMSTOCK MEALYBUG', Organic Preparations and Procedures International, 22: 5, 627 — 629

To link to this Article: DOI: 10.1080/00304949009356335

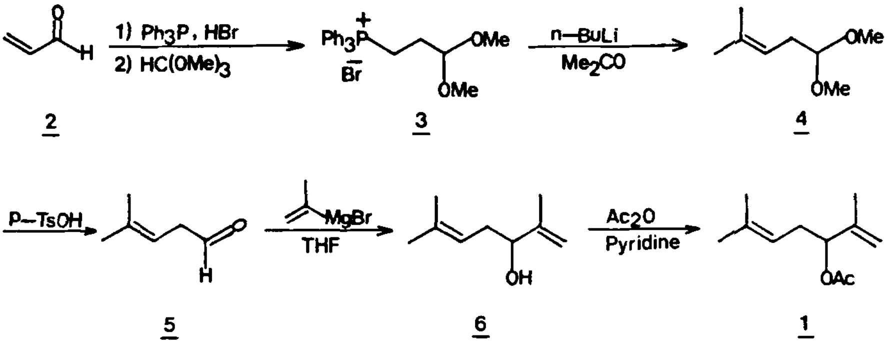
URL: http://dx.doi.org/10.1080/00304949009356335

A SYNTHESIS OF (±)-3-ACETOXY-2,6-DIMETHYL-1,5-HEPTADIENE, THE SEX PHEROMONE OF THE COMSTOCK MEALYBUG

Submitted by (10/23/89)
Suk-Ku Kang* and Choong-Sil Park

Department of Chemistry, Sung Kyun Kwan University
Natural Science Campus, Suwon 440-746, KOREA

The sex pheromone of the Comstock mealybug, *Pseudococcus comstocki* Kuwana, one of the most serious pests of apple, pear and other agricultural crops, has been isolated and identified as (±)-3-acetoxy-2,6-dimethyl-1,5-heptadiene (1) by two groups.[1,2] The synthetic racemate, (±)-1, was highly active as the pheromone.[2,3] However, the natural pheromone was shown to be the dextrorotatory (R)-enantiomer.[4] Two synthesis of (±)-1 and of (+)-1 have been reported.[4,5] We now report the synthesis of (±)-1, based on a three-carbon homologation of acetone with (3,3-dimethoxypropyl)triphenylphosphonium bromide (3);[6] it was efficiently prepared in 90% yield from the reaction of acrolein (2) with triphenylphosphine and hydrobromic acid followed by acetalization with trimethyl orthoformate in a one-pot procedure. The ylide from 3 (by treatment with n-BuLi) was reacted with acetone to provide the β,γ- unsaturated dimethylacetal 4 in 71% yield. Acetal 4 was hydrolyzed with aqueous p-toluenesulfonic acid without isomerization of the double bond to afford aldehyde 5 in 80% yield.[7] Addition of isopropenylmagnesium bromide to 5 furnished (±)-2,6-dimethyl-1,5-heptadien-3-ol (6) in 68%, which on acetylation[3] afforded (±)-1 in 87% yield.



EXPERIMENTAL SECTION

All chemicals and solvents were analytical grade. IR spectra were recorded on a Shimadzu IR-440 spectrophotometer and were calibrated. ^{1}H NMR spectra were obtained in chloroform-d_1 at 80 HMz on a Bruker WP 80 SY spectrometer. ^{13}C NMR spectra (^{1}H-decoupled) were taken in $CDCl_3$ at 22.6 MHz using Me_4Si as an internal standard. Mass spectra were obtained using Hewlett-Packcard 5890 GC/MS system at 70 eV. Column chromatography was performed on Merck silica gel (70-230 mesh).

(3,3-Dimethoxypropyl)triphenylphosphonium Bromide (3).- To a stirred solution of triphenylphosphine (13.1 g, 50 mmol), HBr (47%, 7.0 ml, 60 mmol) in methylene chloride (15 ml) and methanol (15 ml) at -10° was added a solution of acrolein (2, 3.10 g, 55 mmol) in methylene chloride (60 ml). The reaction mixture was stirred at room temperature for 6 hrs. The reaction was monitored by TLC on silica gel (CH_2Cl_2-MeOH, 9:1, $R_f \sim 0.50$). Excess water was removed by decantation. Then trimethyl orthoformate (17.6 ml, 200 mmol) was added rapidly at 0° and the reaction mixture was stirred for 30 min at 0° (checked by TLC on silica gel, CH_2Cl_2/MeOH, 9:1, $R_f \sim 0.55$) and neutralized with triethylamine. The reaction mixture was concentrated under reduced pressure (30 torr) until it was viscous. Addition of benzene afforded the crystalline phosphonium salt. Pentane (60 ml) was added at -40° and the solid was crushed and filtered. Recrystallization from CH_2Cl_2-ether-pentanes (1:2:2) afforded 20.0 g (90%) of 3, mp. 125-128°; IR(KBr): 3050, 1600, 1490, 1445, 1295, 1120, 1085 cm^{-1}; ^1H NMR (80 MHz, $CDCl_3$): δ 1.93 (t, 2H), 3.39 (s, 6H), 3.80 (m, 2H), 4.87 (t, 1H), 7.79 (bs, 15H).

Anal. Calcd. for $C_{23}H_{26}BrO_2P$: C, 62.03; H, 5.88. Found: C, 62.14; H, 6.10

4-Methyl-3-pentenal Dimethylacetal (4).- To a stirred solution of phosphonium salt 3 (2.00 g 4.48 mmol) in dry THF (25 ml) was added n-BuLi (1.55 M in hexane, 2.74 ml, 4.24 mmol) at -40°. The reaction mixture was allowed to warm up to room temperature and stirred for 30 min and then cooled to -78°. Acetone (0.52 g, 8.96 mmol) in dry THF (10 ml) was added at -78° and the mixture then allowed to warm up to room temperature and stirred for 12 hrs. It was quenched with a small amount of saturated NH_4Cl solution and then concentrated in vacuo. The crude product was extracted with ether and washed with water and then brine. The organic layer was dried over anhydrous $MgSO_4$ and concentrated in vacuo. Chromatography on silica gel (CH_2Cl_2, $R_f \sim 0.67$) gave 0.465 g (71%) of 4, bp. 65°/10 mm Hg. IR(neat): 1660, 1415, 1380, 1185, 1110, 1040, 950, 840 cm^{-1}; ^1H NMR (80 MHz, $CDCl_3$): δ 1.65 (s, 3H), 1.75 (s, 3H), 2.30 (t, 2H, J = 7Hz), 3.36 (s, 6H), δ 4.35 (t, 1H, J = 7Hz), 5.15 (t, 1H, J = 7Hz); ^{13}C NMR (22.6 HMz, $CDCl_3$): δ 133.59, 118.34, 104.26, 52.49, 31.62, 25.47, 17.62; MS (m/e): 144 (M^+), 113, 112.

Anal. Calcd. for $C_{20}H_{38}O$: C, 66.63; H, 11.19. Found: C, 66.61; H, 11.24

4-Methyl-3-pentanal (5).- To a stirred solution of acetal 4 (500 mg, 3.46 mmol) in dry THF (15 ml) was added aqueous p-TosOH (0.1 M, 1.7 ml) at room temperature. The reactionmixture was stirred at reflux for 30 min and then neutralized with a saturated NaOAc solution. The reaction mixture was concentrated in vacuo and extracted with pentanes. The organic extract was washed with brine and dried over anhydrous $MgSO_4$. Concentration in vacuo and Kügelrohr distillation (50°/10 mmHg) afforded 270 mg (80%) of 5. IR(neat): 2850, 2750, 1715 cm^{-1}; ^1H NMR (80 MHz, $CDCl_3$): δ 1.65 (s, 3H), 1.75 (s, 3H), 3.13 (d, 2H, J = 7Hz), 5.15 (t, 1H, J = 7Hz), 9.60 (t, 1H, J = 2Hz); the IR and ^1H NMR spectra of 5 were identical in all respects to those reported.[7]

(±)-2,6-Dimethyl-1,5-heptadien-3-ol (6).- To a stirred solution of isopropenylmagnesium bromide [1.300 g, 4.1 mmol prepared from magnesium turnings (0.120 g) in dry ether (5 ml) and 2-bromopropene (0.496 g) in dry ether (5 ml)] at -10° under nitrogen atmosphere was added aldehyde

5 (199 mg, 2.03 mmol) in dry ether (5 ml). The reaction mixture was stirred at room temperature for 2 hrs. The reaction mixture was quenched with a small amount of dilute H_2SO_4 solution and then extracted with ether. The organic layer was washed with saturated $NaHCO_3$, brine and dried over anhydrous $MgSO_4$. Concentration in vacuo and subsequent chromatography on silica gel [ether/benzene (1:5)] gave 193 mg (83%) of (±)-6, bp. 60-70°/10 mm Hg; IR(neat): 3400, 2900, 1640, 1440, 1370, 1100, 890 cm^{-1}; ^1H NMR (80 MHz, $CDCl_3$): δ 1.69 (s, 3H), 1.80 (s, 6H), 2.20 (d, 3H, J = 7Hz), 4.07 (t, 1H, J = 7Hz), 4.60-5.20 (m, 3H). IR and ^1H NMR spectra of 6 were identical in all respects with those reported.[3]

Acknowledgement.- Financial support from the Korea Science and Engineering Foundation is gratefully acknowledged. We are thankful to Dr. Ki-Jun Hwang, KRICT, Daejon, Korea for recording the MS spectra and for his encouragement.

REFERENCES

1. T. Negishi, M. Uchida, Y. Tamaki, K. Mori, T. Ishiwatari, S. Asano and K. Nakagawa, Appl. Ent. Zool., 15, 328 (1980).
2. B. A. Bier-Leonhardt, D. S. Moreno, M. Schwartz, H. S. Foster, J. R. Plimmer and E. D. Devilbiss, Life Science, 27, 399 (1980).
3. M. Uchida, K. Nakagawa, T. Nedishi, S. Asano and K. Mori, Agric. Biol. Chem., 45, 369 (1981).
4. K. Mori and H. Ueda, Tetrahedron, 37, 2581 (1981).
5. N. Nakagawa and K. Mori, Agric. Biol. Chem., 48, 2799 (1984).
6. Review: J. C. Stowell, Chem. Rev., 84, 409 (1984).
7. (a) N. J. Morrison, J. Chem. Soc. Perkin Trans 1, 3027 (1982). (b) B. T. Gröbel and D. Seebach, Synthesis, 357 (1977).

****