

Synthesis of Methyl 11-(2'-Methylphenyl)Undecanoate

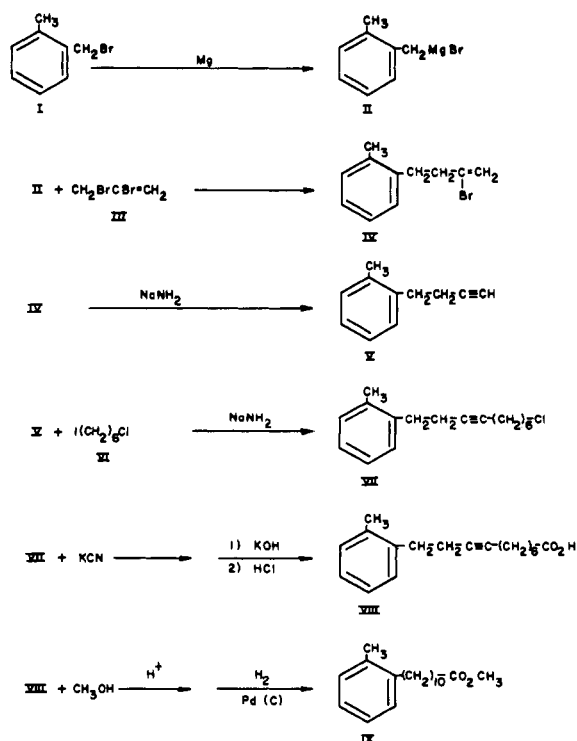
William R. Michael

The Proctor & Gamble Co., Miami Valley Laboratories, Cincinnati, Ohio

The synthesis of methyl 11-(2'-methylphenyl)undecanoate, a compound prepared by dehydrogenation of a cyclic compound isolated from heated linseed oil, is reported. This synthetic route offers a means of introducing carbon-14 or tritium into the molecule in fair yield near the end of the reaction sequence.

METHYL 11-(2'-methylphenyl)undecanoate was one compound prepared by dehydrogenation of a cyclic compound isolated from the thermal reaction of linseed oil (5). The synthesis of this compound has been reported (5); however, the author desired to develop a synthesis which would offer a convenient means of introducing radiocarbon or tritium into the molecule. The resulting labeled ester and its hydrogenated derivative would be expected to be useful in a metabolism study of aromatic and cyclic compounds.

α -Bromo-*o*-xylene (I) was allowed to react with magnesium. The resulting Grignard reagent (II) was added to a solution containing 2, 3-dibromopropene (III) to yield 2-bromo-4-(2'-methylphenyl)-1-butene (IV). 4-(2'-Methylphenyl)-1-butyne (V) was produced by dehydrohalogenation of the 2-bromo-1-butene. The sodium salt of the acetylenic compound was condensed with 1-chloro-6-iodohexane (VI) to form 10-(2'-methylphenyl)-7-decynyl chloride (VII). Interaction of the chloride with potassium cyanide afforded nitrile which was hydrolyzed to 11-(2'-methylphenyl)undecynoic acid (VIII). Esterification of the acid followed by hydrogenation of the triple bond gave the desired methyl 11-(2'-methylphenyl) undecanoate (IX). The synthetic ester was identical in all respects to the synthetic compound prepared by Hutchison and Alexander (5).



This synthetic route permits introduction of carbon-14 and tritium into the molecule in fair yield near the end of the reaction sequence. The use of potassium cyanide labeled with carbon-14 would yield a product having a labeled carboxyl group. Reduction of the triple bond with tritium gas would yield a product having tritium on carbon atoms 8 and 9.

EXPERIMENTAL

2-Bromo-4-(2'-methylphenyl)-1-butene (IV). The Grignard reagent, prepared at 0° C. from 100 grams (0.54 mole) of α -bromo-*o*-xylene (I), was added slowly with cooling and under nitrogen to a flask containing 80 grams (0.40 mole) of 2,3-dibromopropene in 200 ml. of ether. When the addition of the reagent was complete, two hours' additional stirring, hydrolysis, extraction, and distillation yielded 28 grams (32%) of product; boiling 85-90° C. at 3.5 mm., n_D^{25} 1.5478.

Anal. Calcd. for $C_{11}H_{13}Br$: C, 58.7; H, 5.8; Br, 35.5. Found: C, 58.6; H, 5.9; Br, 34.2.

4-(2'-Methylphenyl)-1-butyne (V). 2-Bromo-4-(2'-methylphenyl) butene (20 grams, 0.089 mole) was added over a period of 2 hours to a stirred suspension of 12 grams (0.31 mole) of sodium amide in 200 ml. of heavy mineral oil. The mixture was kept at 160° C. during the addition and for two hours thereafter. Hydrolysis, extraction, and distillation yielded 8 grams (62.4%) of product; boiling point 85° C. at 5 mm. The infrared spectrum showed the following bands: $C \equiv CH$ (3μ); $C \equiv C$ (4.65μ) (4).

Anal. Calcd. for $C_{11}H_{12}$: C, 91.6; H, 8.4. Found: C, 90.3; H, 8.6.

10-(2'-Methylphenyl)-7-decynyl chloride (VII). 10-(2'-Methylphenyl)-7-decynyl chloride was prepared by the condensation of 1-chloro-6-iodohexane (VI) and 4-(2'-methylphenyl)-1-butyne (V), according to the method of Strong *et al.* (1, 2, 6) and Baker and Gunstone (3). The product was distilled at 200° C. at 5 mm. with a 35% yield. The refractive index was η_D^{25} 1.5068.

Anal. Calcd. for $C_{17}H_{23}Cl$: C, 77.7; H, 8.8; Cl, 13.3. Found: 76.2; H, 8.8; Cl, 12.7.

Methyl 11-(2'-methylphenyl)undecylate (IX). One gram of 10-(2'-methylphenyl)decynyl chloride (VII) in 10 ml. of ethanol was added to a solution of 0.5 gram of potassium cyanide in 2 ml. of water. The mixture was heated under reflux for 24 hours after which 1 gram of sodium hydroxide was added and the heating was continued an additional 24 hours. After evaporation of the solvent, water was added to the residue, and the neutral materials were extracted with hexane. The aqueous solution was acidified and extracted with ether. The ether solution was washed with water and dried over sodium sulfate; evaporation yielded 0.478 gram (47%) of acid (VIII). The acid was refluxed with 25 ml. of absolute methanol and 0.25 ml. of hydrochloric acid. The crude ester was water-washed

and hydrogenated for 2 hours in a Parr apparatus using Adams' catalyst at room temperature and 50 p.s.i. The yield was 0.433 gram. The product was chromatographed on Florisil (10 grams, 1 × 15 cm. column) and eluted with 1500 ml. of hexane. The yield was 0.316 gram (63%). The infrared spectrum showed the following bands: aromatic ortho-substituted benzene (3.21, 6.22, 6.70, 13.35 μ); ester (5.72, 8.50 μ). Analysis by NMR gave the following τ values: aromatic protons (3.02 p.p.m.); methyl ester protons (6.40 p.p.m.); activated methyl and activated methylene protons (7.30 to 8.00 p.p.m.); methylene protons (8.00 to 8.90 p.p.m.).

Anal. Calcd. for $C_{19}H_{20}O_2$: C, 78.6; H, 10.4. Found: C, 78.9; H, 10.3.

LITERATURE CITED

- (1) Ahmad, K., Bumpus, F.M., Strong, F.M., *J. Am. Chem. Soc.* **70**, 3391 (1948).
- (2) Ahmad, K., Strong, F.M., *Ibid.*, **70**, 1699 (1948).
- (3) Baker, C.D., Gunstone, F.D., *J. Chem. Soc.* **1963**, p. 489.
- (4) Bellamy, L.J., "The Infra-red Spectra of Complex Molecules," p. 58, New York, 1954.
- (5) Hutchison, R.B., Alexander, J.C., *J. Org. Chem.* **28**, 2522 (1963).
- (6) Taylor, W.R., Strong, F.M., *J. Am. Chem. Soc.* **72**, 4263 (1950).

RECEIVED for review February 8, 1965. Accepted September 15, 1965.

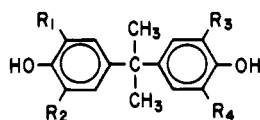
Syntheses of Some Brominated 4,4'-Isopropylidenebisphenols

HENRY E. HENNIS and LEONARD R. THOMPSON

Benzene Research Laboratory, Midland Division, The Dow Chemical Co., Midland, Mich.

4, 4'-Isopropylidenediphenyl acetate (diacetate ester of bisphenol A) was converted to the monoester, α -(*p*-hydroxyphenyl)-*p*-cumenyl acetate, in 25% yield by selective methanolysis in the presence of a catalytic quantity of sodium methoxide. Bromination of the monoester with an equimolar amount of bromine followed by saponification yielded 2-bromo-4,4'-isopropylidenediphenol in 44% yield. Bromination with two molar equivalents of bromine and subsequent saponification gave 2,6-dibromo-4,4'-isopropylidenediphenol in 70% yield. 2,2',6-Tribromo-4,4'-isopropylidenediphenol slowly crystallized from an oil prepared by the bromination of bisphenol A with three molar equivalents of bromine (11% yield). All of the brominated bisphenols were further characterized by acetylation to the diacetate esters and complete bromination to the known tetrabromobisphenol A. The infrared absorption spectra of the subject compounds were also recorded.

PURE SAMPLES of the intermediates encountered in the bromination of 4,4'-isopropylidenebisphenol (bisphenol A, I) to 4,4'-isopropylidenebis-(2,6-dibromophenol) or tetrabromobisphenol A (VI) (2) were required for a thorough study of the reaction. The following intermediates were involved: monobrominated bisphenol A (II), two isomers of dibrominated bisphenol A (III and IV), and tribrominated bisphenol A (V), respectively.

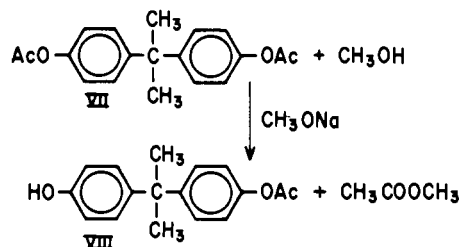


Compound	R ₁	R ₂	R ₃	R ₄
I	H	H	H	H
II	Br	H	H	H
III	Br	H	Br	H
IV	Br	Br	H	H
V	Br	Br	Br	H
VI	Br	Br	Br	Br

Only the symmetrically dibrominated intermediate III was known (3). Therefore, this study was primarily concerned with the preparation of unsymmetrically brominated bisphenols II, IV, and V. It is believed that the methods evolved may be applicable to other similar synthetic situations.

The approach considered most favorable to prepare monobrominated bisphenol A (II) and the unsymmetrically dibrominated compound IV was via the intermediate, α -(*p*-hydro-

xyphenyl)-*p*-cumenyl acetate (bisphenol A monoacetate, VIII). The two rings in this molecule should differ sufficiently in reactivity toward electrophilic substitution to permit selective bromination. The preparation of VIII was more difficult than anticipated. Monoesterification of bisphenol A with a number of acetylation reagents and monosaponification of bisphenol diacetate (VII) under a variety of conditions failed to give practical quantities of VIII. The only reliable synthetic method available was the methanolysis of bisphenol A diacetate in the presence of a catalytic amount of sodium methoxide. Chromatography over alumina of the reaction product removed unreacted starting material and bisphenol A and a 25% yield of VIII was achieved.



The bromination of bisphenol A monoacetate appeared to proceed in a marked stepwise fashion. The second bromine substitution proceeded noticeably slower than the first. This is due to the deactivation of the ring by the inductive effect of the bromine atom already present (1). The mono- and dibrominated monoacetates were saponified without isolation to yield monobrominated bisphenol A (II) and unsymmetrically dibrominated bisphenol A (III) in 44 and 70% yields, respectively.