data showing the yields of turpentine from an average tree.

Experiments are described, which show that the gum turpentine from Torrey pine contains approximately 75% *l*-limonene, 10% *n*-decylaldehyde, 5% *n*-undecane, 4% longifolene, 0.2% laurylaldehyde and 0.2% of an unidentified C_{10} carbonyl compound, together with less than 0.1% each of nonane and heptane. The occurrence of the paraffin hydrocarbon in Torrey pine turpentine is indicative that the Torrey pine is closely related biochemically, as well as morphologically, to the Digger pine and the Coulter pine.

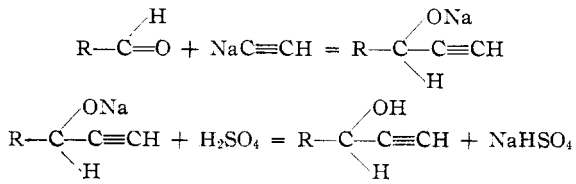
PASADENA, CALIF. RECEIVED FEBRUARY 18, 1947

[CONTRIBUTION FROM THE CHEMISTRY LABORATORY OF INDIANA UNIVERSITY]

Concerning Aromatic Acetylenic Carbinols

BY PHYLLIS RUTAN[1] AND CLARENCE E. MAY

Numerous aldehydes and ketones have been combined successfully with sodium acetylide under varying conditions to form acetylenic carbinols. Of the aromatic aldehydes reported[2,3] benzaldehyde was the only aromatic aldehyde that gave a good yield of its corresponding acetylenic carbinol.



Two methods of synthesis of acetylenic carbinols are those of Jones and McCombie[4] and Zeitner and Genas.[5]

The present authors have attempted the synthesis of acetylenic carbinols from the following aromatic aldehydes: phenylacetaldehyde, *p*-dimethylaminobenzaldehyde, cinnamic aldehyde, 4-ethoxyvanillin, *p*-methoxybenzaldehyde, *o*-methoxybenzaldehyde, *p*-chlorobenzaldehyde and salicylaldehyde.

Since phenylethynylcarbinol was produced in a 61% yield by the use of the Jones–McCombie method and in a 35% yield by the Zeitner–Genas method, most of our work centered around the use of the various aldehydes with the former method. To ascertain whether an acetylenic carbinol had been formed we found useful the production of an explosive yellowish silver acetylide.[6]

Experimental

***p*-Methoxyphenylethynylcarbinol.**—In a three-necked flask equipped with a mechanical stirrer, cooled with a bath of Dry Ice in methanol, 23 g. of sodium in a liter of liquid ammonia was treated with acetylene until the blue color of the solution had disappeared. A steady stream of acetylene generated by water under pressure dripping on a charge of 100 g. of calcium carbide was passed through the ammonia solution. The acetylene was purified by passage respectively through a solution containing 10% chromic acid in 20% sulfuric acid, a 10% copper nitrate solution in 20% nitric acid, a 10% sodium hydroxide solution and a calcium chloride drying tube.

To the sodium acetylide solution was added gradually a solution of 135 g. anisaldehyde dissolved in 100 ml. of dry ether. An hour was usually required for the addition of the aldehyde solution. Meanwhile, acetylene was passed through the ammonia solution in a continuous fast bubbling stream. This was continued for three hours after the aldehyde was added.

After the evaporation of the ammonia the residue was treated with ice and 50% sulfuric acid until the mixture became acidic toward congo red paper. The mixture was then ether extracted and the extract was dried with calcium chloride. A few crystals of hydroquinone were added to protect the product during the final distillation in an atmosphere of nitrogen. A 61.9% theoretical yield of *p*-methoxyphenylethynylcarbinol, b. p. 123.5°, 0.5 mm., was obtained.[7] It was pale yellowish oil that crystallized on standing and melted at 172–173°. The product gave no color with ferric chloride and formed no 2,4-dinitrophenylhydrazone. The dry silver acetylide burned with explosive violence.

Anal. Calcd. for $C_{10}H_{10}O_2$: C, 74.05; H, 6.22. Found: C, 73.59; H, 5.96.

p-Methoxyphenylethynylcarbinol yielded a mercury derivative when 1.62 g. of the carbinol dissolved in 35 ml. of ethanol was allowed to react with 160 ml. of the alkaline mercuric iodide solution of Johnson and McEwan.[8] The mercury derivative was obtained as a white precipitate. This was crystallized from alcohol and 2.4 g. of white needles, m. p. 185°, was recovered.

***o*-Methoxyphenylethynylcarbinol.**—*o*-Methoxybenzaldehyde was made in 88% yield by the Blatt method.[9] In the same manner as previously described for making *p*-methoxyphenylethynylcarbinol, an 88% yield of *o*-methoxyphenylethynylcarbinol was obtained as a pale yellow oil, b. p. 115.7°, 1.0 mm., from *o*-methoxybenzaldehyde.

Anal. Calcd. for $C_{10}H_{10}O_2$: C, 74.05; H, 6.22. Found: C, 73.65; H, 6.68.

From this preparation of *o*-methoxyphenylethynylcarbinol was made a mercury derivative that melted at 138°.

***p*-Chlorophenylethynylcarbinol.**—*p*-Chlorobenzaldehyde gave a 6.0% yield of *p*-chlorophenylethynyl carbinol, b. p. 105°, 3.0 mm., when distilled in an atmosphere of nitrogen. A cryoscopic molecular weight determination showed a value of 164.8. The theoretical value for $C_{10}H_{10}OCl$ was 166. The corresponding mercury derivative was made and found to melt at 195°.

(1) Abstracted from a thesis submitted May 1, 1946 to the faculty of the Graduate School in partial fulfilment of the requirements for the degree Master of Arts, Indiana University.

(2) Hess and Munderloh, *Ber.*, **51**, 377 (1918).

(3) Campbell, Campbell and Eby, THIS JOURNAL, **60**, 2833 (1938).

(4) Jones and McCombie, *ibid.*, **64**, 933 (1942).

(5) Zeitner and Genas, U. S. Patent 2,345,170, March 28, 1944.

(6) Rupe and Vonaesch, *Ann.*, **442**, 79 (1925).

(7) All boiling points and melting points mentioned are uncorrected.

(8) Johnson and McEwan, THIS JOURNAL, **48**, 469 (1926).

(9) Blatt, "Organic Syntheses," Coll. Vol. II, John Wiley and Sons, New York, N. Y., 1943, p. 619.

p-Dimethylaminophenylethynylcarbinol, o-Hydroxyphenylethynylcarbinol and Benzylethynylcarbinol each resulted in fair yields for the use of the respective aromatic aldehydes. In no case did the product hold together through a distillation under strongly reduced pressure in an atmosphere of nitrogen. Usually the aldehyde was recovered in good amounts from these cleavages.

Phenylethynylcarbinol.—For use in the Zeitner–Genas method of synthesis of acetylenic carbinols which follows, methylal was made in 75% yield by refluxing 380 g. of powdered paraformaldehyde and 1200 ml. of methanol containing 1.0% dry hydrogen chloride. In a large iron mortar 90 g. of potassium hydroxide was pulverized very easily to a dust under 250 ml. of methylal. In a three-necked flask equipped with a mechanical stirrer was placed the suspension of potassium hydroxide and methylal. On cooling to 0° in an ice–salt-bath about two-thirds of the necessary acetylene was bubbled fast through the solution. A solution of 53 g. of benzaldehyde dissolved in 50 g. of methylal was added dropwise. After continuous cooling, stirring and passage of acetylene for another hour the reaction was interrupted by the addition of 400 ml. of water. The mixture was saturated with salt and the methylal layer was separated. After drying the solution and distilling the methylal, the residue was distilled in an atmosphere of nitrogen. A 35% theoretical yield of phenylethynyl carbinol, b. p. 80–85° (1.5 mm.), 112° (11–12 mm.), was obtained.

When the Zeitner–Genas method was used none of the aromatic aldehydes gave better yields than were obtained by the Jones–McCombie method.

Summary

p-Methoxybenzaldehyde and *o*-methoxybenzaldehyde gave good yields of their corresponding acetylenic carbinols by the Jones–McCombie method. These carbinols yielded their characteristic mercury derivatives.

p-Chlorobenzaldehyde gave a poor yield of *p*-chlorophenylethynylcarbinol.

Phenylacetaldehyde, *p*-dimethylaminobenzaldehyde and salicylaldehyde formed products too fragile to stand distillation.

There was no indication of any reaction when cinnamic aldehyde and 4-ethoxyvanillin were used under the conditions commonly employed.

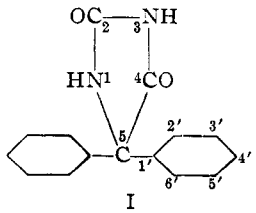
BLOOMINGTON, INDIANA RECEIVED MARCH 6, 1947

[CONTRIBUTION FROM THE DEPARTMENT OF CHEMISTRY, THE UNIVERSITY OF TEXAS]

Certain 5-Phenyl-5-(Substituted Phenyl)-hydantoins[1]

BY JOSEPH WELDON MELTON[2] AND HENRY R. HENZE

Previous to the introduction of the sodium salt of 5,5-diphenylhydantoin[3] by Merritt and Putnam,[4] no drug was available for the satisfactory control of the *grand mal* type of epilepsy. The fact that 5,5-diphenylhydantoin (I) has rather limited aqueous solubility and the further fact that a *p*H of 11.7 is required to keep its sodium salt in solution indicate that some improvement over this drug should be sought. Although a considerable number of derivatives of I have been made and tested,[5] all have been found to possess decreased anticonvulsant activity. However, in these derivatives, the substituents in one or both of the phenyl groups are located in positions *ortho* or *para* or both *ortho* and *para* to the point of attachment of the phenyl group to the hydantoin nucleus.



I

In general, these hydantoins have been prepared from the appropriately substituted benzophenones by use of the Bucherer procedure[6] as modified in this Laboratory.[7] It was hoped that the introduction of the 3′-hydroxyl group might improve the solubility of the hydantoin derivative and lower the alkalinity of aqueous solutions of the sodium salt. Likewise, the 3′-amino derivative offered the possibility of utilizing the hydrochloride or other salt for administration.

A second group of hydantoins, prepared in this study, contained a 5-phenyl group and a 5-(4-hydroxyphenyl) or 5-(4-aminophenyl) group further substituted by bromine or iodine in the 3′- or 3′,5′ positions. The appropriate halogenated derivatives of 4-aminobenzophenone all formed hydantoins readily, but it was necessary first to prepare 5-(4-hydroxyphenyl)-5-phenylhydantoin for subsequent halogenation in order to obtain the derivatives related analogously to 4-hydroxybenzophenone.

Experimental

Preparation of *m*-Substituted Benzophenones.—Seven metasubstituted benzophenones were prepared by conventional methods; the substituent groupings included the amino,[8] bromo,[9] carboxyl,[10] chloro,[11] hydroxyl,[11]

(1) From the Ph. D. dissertation of J. W. Melton, June, 1946.

(2) Present address: Department of Chemistry, Northwestern State College, Alva, Okla.

(3) Introduced by Parke, Davis and Company as "Dilantin"; recognized in U. S. P. XII as "diphenylhydantoin sodium."

(4) Merritt and Putnam, *Arch. Neurol. Psychiat.*, **39**, 1003 (1938); *J. Am. Med. Assoc.*, **111**, 1068 (1938).

(5) Merritt, Putnam and Bywater, *J. Pharmacol.*, **84**, 67 (1945).

(6) Bucherer and Lieb, *J. prakt. Chem.*, [2] **141**, 5 (1934).

(7) Henze and Long, THIS JOURNAL, **63**, 1941 (1941).

(8) Geigy and Koenigs, *Ber.*, **18**, 2401 (1885).

(9) Koopal, *Rec. trav. chim.*, **34**, 153 (1915).

(10) Smith, THIS JOURNAL, **43**, 1920 (1921).

(11) Smith, *Ber.*, **24**, 4044 (1891).