with 5.5 g. (0.02 mole) of phosphorus tribromide added dropwise at such rate that the temperature did not exceed 10°. The mixture was allowed to stand at room temperature for 4 hr., water was added, and the mixture was extracted with ether. The ether extracts were washed with sodium carbonate solution, with water, and finally dried over Drierite. Distillation gave 8.6 g. (90%) of 1-bromo-2-(3,5-dimethyl-1-naphthyl)ethane, b.p. 173–175° (3 mm.).

Anal. Calcd. for $C_{14}H_{15}Br$: Br, 30.4. Found: Br, 30.19.

α-Isopropyl-γ-(3,5-dimethylnaphthyl-1)butyric acid. 1-Bromo-2-(3,5-dimethyl-1-naphthyl)ethane, 26 g. (0.1 mole), was added slowly to a boiling solution of the sodium salt of diethyl isopropylmalonate. (This latter reactant was prepared from 2.4 g. (0.1 atom) of sodium, 21 g. (0.1 mole) of diethyl isopropylmalonate, and 4.8 g. (0.1 mole) of ethanol in 60 ml. of anhydrous toluene at reflux for 21 hr.) The reaction mixture was heated to reflux for 12 hr. The toluene was removed in vacuo, and the residual oil was taken up in ether and washed with water. Evaporation of the ether left a residue which was heated to reflux for 8 hr. with a solution of 20 g. (0.35 mole) of potassium hydroxide in 20 ml. of water. The system was cooled, 15 ml. of water was added, and the mixture was extracted with two 20-ml. portions of benzene. The clear aqueous solution was treated cautiously with 50 ml. of 10*N* sulfuric acid, and heated to reflux for 6 hr. The cooled mixture was extracted with three 100-ml. portions of ether. The combined extracts were dried over Drierite and distilled to give 8.3 g. (29%) of α-isopropyl-γ-(3,5-dimethyl-1-naphthyl)butyric acid, b.p. 225–227° (1.5 mm.).

Anal. Calcd. for $C_{19}H_{24}O_2$: Neutral equiv., 284. Found: Neutral equiv., 281.

8,10-Dimethyl-2-isopropyl-1-keto-1,2,3,4-tetrahydrophenanthrene (XVIII). α-Isopropyl-γ-(3,5-dimethyl-1-naphthyl)-butyric acid, 4.5 g. (0.016 mole), was dissolved in 20 ml. of benzene, and 4.3 g. (0.2 mole) of phosphorus pentachloride was added. The system was allowed to stand at room temperature for 1 hr., and was then heated in the water bath for 5 min. The resulting solution was cooled to 5°, 4.5 ml. (0.38 mole) of stannic chloride was added, and the system was allowed to stand at 5° for 15 min. with occasional stirring. The reaction complex was then decomposed by the addition with stirring of dilute hydrochloric acid precooled to 5°. The organic phase was separated, washed with water, and dried over Drierite. Evaporation of the benzene left a yellow oil which rapidly crystallized. Two crystallizations from methanol gave 3.2 g. (76%) of 8,10-dimethyl-2-isopropyl-1-keto-1,2,3,4-tetrahydrophenanthrene, m.p. 56–58°.

Anal. Calcd. for $C_{19}H_{22}O$: C, 85.8; H, 8.27. Found: C, 85.62; H, 8.08.

1,8,10-Trimethyl-2-isopropylphenanthrene (V). 8,10-Dimethyl-2-isopropyl-1-keto-1,2,3,4-tetrahydrophenanthrene, 3.0 g. (0.011 mole), in 15 ml. of anhydrous ether was added at 5° to an ether solution of methyl magnesium iodide prepared from 7 g. (0.049 mole) of methyl iodide in 20 ml. of ether. The system was allowed to stand overnight under a moisture trap, then poured into cold dilute hydrochloric acid. The ether layer was separated and dried over Drierite. The ether was evaporated, and the residue was dehydrogenated over 1.0 g. of 10% palladium on charcoal at 310° for 1.5 hr. in a nitrogen atmosphere. The system was cooled and the reaction product taken up in ether. Filtration and evaporation of the ether left an oil which rapidly crystallized. Crystallization from methanol gave 2.6 g. (81%) of 1,8,10-trimethyl-2-isopropylphenanthrene, m.p. 85–86°; picrate, m.p. 175–176°.

A mixture of this synthetic material and the 1,8,10-trimethyl-2-isopropylphenanthrene produced by dehydrogenation of 8,9-dimethyloltetrahydroabietic acid melted at 83–85°, while a mixture of the picrates melted at 175–177°.

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[CONTRIBUTION FROM THE DEPARTMENT OF CHEMISTRY, COLUMBIA UNIVERSITY]

On the Preparation and Structure of a Glycoside of 3-Pentadecylcatechol, and the Monomethyl Ether and Monobenzoyl Ester Intermediates

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The reaction of 3-pentadecylcatechol with α-bromoacetoglucose followed by the hydrolysis of the product yielded a monoglycoside of 3-pentadecylcatechol melting at 105.5–106°. One of the monomethyl ethers of 3-pentadecylcatechol, namely, 1-methoxy-2-hydroxy-3-pentadecylbenzene, m.p. 46.5°, has been synthesized starting from *o*-vanillin. Mixtures of isomeric monomethyl ethers, monobenzyl ethers and monobenzoyl esters of 3-pentadecylcatechol were obtained by the direct reaction of 3-pentadecylcatechol with the appropriate reagent and each mixture was resolved by chromatography on alumina. Thus, the following compounds have been isolated: 1-methoxy-2-hydroxy-3-pentadecylbenzene, m.p. 46.5°; 1-hydroxy-2-methoxy-3-pentadecylbenzene, m.p. 43.5°; 1-benzoyl-2-hydroxy-3-pentadecylbenzene, m.p. 61.0°; and 1-hydroxy-2-benzoyl-3-pentadecylbenzene, m.p. 67.3°. The structure of the monobenzoyl ester (m.p. 67.3°) was arrived at by converting it to 1-methoxy-2-hydroxy-3-pentadecylbenzene. The reaction of 1-hydroxy-2-benzoyl-3-pentadecylbenzene with α-bromoacetoglucose and subsequent hydrolysis of the product yielded the monoglycoside, melting at 105.5–106.0°. The monoglycoside isolated from 3-pentadecylcatechol either directly or *via* its monobenzoyl ester has the structure 1-glucosidyl-2-hydroxy-3-pentadecylbenzene.

The four components of the poison-ivy principle have recently been structurally identified[2,3] and the saturated and monoolefinic components have

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(2) W. F. Symes and C. R. Dawson, *J. Am. Chem. Soc.*, **76**, 2959 (1954).

(3) C. R. Dawson, *Trans. N. Y. Acad. Sci.*, **18**, 427 (1956).

been synthesized.[4,5] The saturated component, 3-pentadecylcatechol (hydrourushiol) has been advocated as a model compound for the clinical investigation of poison-ivy dermatitis,[6] and recently has been investigated as a prophylactic agent in poison-ivy therapy.[7] As a result of these clinical studies, interest has developed in the possible utilization of a 3-pentadecylcatechol having modified lipophylic properties. It seems possible that a derivative having greater hydrophylic character and possessing the property of releasing 3-pentadecylcatechol via slow hydrolysis might have enhanced value in the clinical work. For this reason the synthesis of a glycoside of 3-pentadecylcatechol has been investigated.

In preliminary experiments it was observed that the easily oxidizable nature of 3-pentadecylcatechol prevented its direct reaction with reagents commonly employed for the preparation of glycosides. Thus, the interaction of the catechol and tetraacetyl-α-glucosidyl bromide in quinoline solution in the presence of silver oxide[8] or silver carbonate[9] gave a dark, gumlike product. A similar nondistinguishable product was obtained when the catechol was reacted with pentaacetyl-β-D-glucopyranose in benzene solution containing stannic chloride.[10]

A modified procedure of the reaction between tetraacetylglycosidyl bromide and 3-pentadecylcatechol, however, yielded a small percentage of a tetraacetyl monoglycoside (VIII, Chart I). This compound after hydrolysis and purification gave white crystals melting at 106° and analyzing correctly for a monoglycoside of 3-pentadecylcatechol (IX). No evidence was obtained for a diglycoside.

Because of the low yield of the glycoside obtained as described above, and because of its uncertain structure as to the position of the glycosidyl group, a new route of synthesis was investigated. The successful synthesis of the same monoglycoside in good yield and proof of its structure was accomplished in the following way. One of the two possible monobenzoyl esters of 3-pentadecylcatechol (subsequently shown to have the structure 1-hydroxy-2-benzoyl-3-pentadecyl benzene XI) reacted with tetraacetyl-α-glucosidyl bromide in quinoline in the presence of silver oxide to give the tetraacetyl glycoside (XII). On treatment of this compound with methyl alcoholic ammonia, removal of the benzoyl and acetyl groups was effected and the free monoglycoside (IX) thus obtained melted at 106°. The identical structure of these two preparations of the monoglycoside of 3-pentadecylcatechol was confirmed by their mixed melting point.

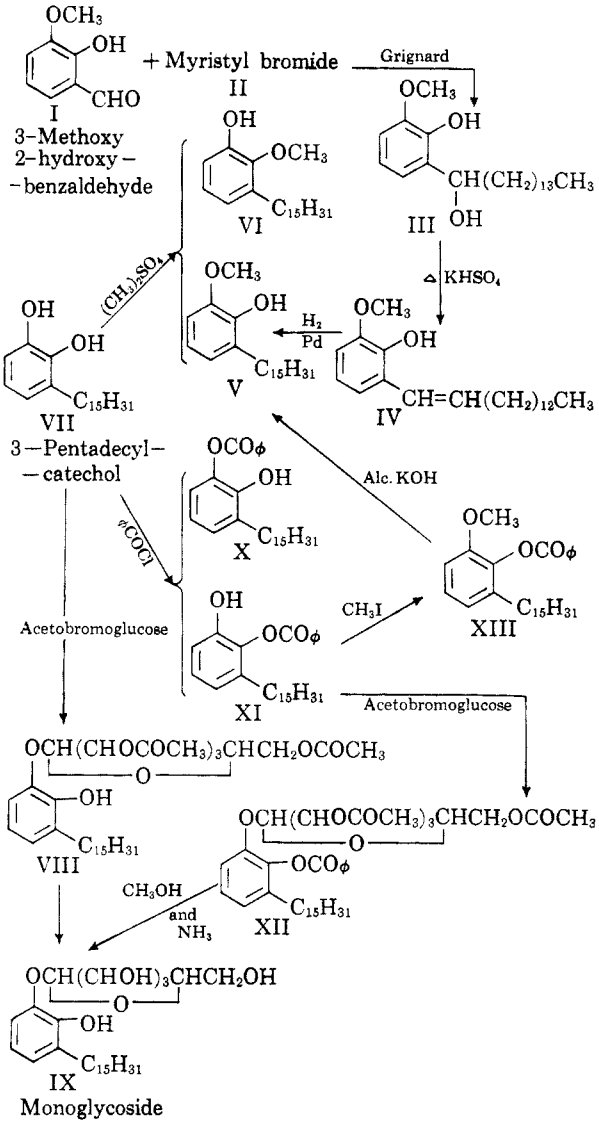

Fig. 1. Synthesis of 1-methoxy 2-hydroxy-3-pentadecylbenzene (V) and the proof for the structure of the monoglycoside of 3-pentadecylcatechol (IX)

The monobenzoyl ester (XI) used in the preparation of the glycoside was isolated by chromatographic resolution of a mixture of the two monobenzoyl esters obtained directly by the reaction of equimolar amounts of benzoyl chloride and pentadecylcatechol in pyridine medium. After a series of trial experiments, a procedure was developed for the separation of a mixture of monobenzoyl esters of pentadecylcatechol containing small amounts of the unreacted catechol and its dibenzoyl ester. The method utilized the chromatographic separation of a mixture of these four components on an acid-washed alumina column. On elution of the mixture with pentane, the unreacted pentadecyl-

(4) C. R. Dawson, D. Wasserman, and H. Keil, *J. Am. Chem. Soc.*, **68**, 534 (1946).
(5) B. Loev and C. R. Dawson (to be published).
(6) H. Keil, D. Wasserman, and C. R. Dawson, *J. Allergy*, **16**, 275 (1947).
(7) A. Kligman, *A.M.A. Archives of Dermatology*, **77**, 149–180 (1958).
(8) A. Robertson and R. B. Waters, *J. Chem. Soc.*, 2729 (1930).
(9) W. Koenigs and E. Knorr, *Ber.*, **34**, 957 (1901).
(10) Theilheimer, Synthetic Methods of Organic Chemistry, Interscience Publishers, Inc., New York, 1955, 142.

catechol, which was strongly absorbed by the alumina, remained on the upper portion of the column, whereas the dibenzoyl ester (m.p. 60°) appeared in the first eluent fractions. The two monobenzoyl esters were subsequently found in the central regions of the column, with the 1 hydroxy isomer at a higher position on the column than the 2 hydroxy isomer.

The column was extruded and the monobenzoyl ester segments were extracted with ether and rechromatographed on acid washed alumina using pentane. This second chromatography yielded two separate fractions of monobenzoyl esters differing in their melting points and ultraviolet absorption spectra. These two fractions were separately chromatographed on alumina using pentane and the middle fraction from each chromatographic column was isolated and recrystallized from ethanol to give the two isomeric monobenzoyl esters (X and XI) melting, respectively, at 61.0° and 67.3°. It may be added that attempts to prepare the glycoside from the benzoyl ester melting at 61° (X) were not successful whereas the ester melting at 67.3° (XI) gave the glycoside (XII) in over 80% yield.

In order to establish the position of the benzoyl ester group, a sample of XI was methylated to the corresponding monoether monoester of pentadecylcatechol (XIII). This ether ester was now hydrolized with methyl alcoholic potassium hydroxide to give a monomethyl ether of pentadecylcatechol (V) in which the position of the methoxy group represented the free hydroxy group in the original monobenzoyl ester. The monomethyl ether thus prepared melted at 46.0°.

R. Majima[11] had previously reported the preparation of a single monomethyl ether of pentadecylcatechol, melting at 44°, by direct methylation of Japanese lac with equimolar amounts of dimethyl sulfate followed by fractional distillation and hydrogenation of the product. Majima assigned this monomethyl ether the structure, 1-methoxy-2-hydroxy-3-pentadecylbenzene (same as V), on the basis of its similarity in the formation of ferric complexes to that of the corresponding toluene derivative of known structure. No definite synthetic evidence as regards the position of the methoxy group was supplied by Majima and furthermore he did not supply evidence as to the formation of the other possible isomeric monomethyl ether. Consequently Majima's arguments for the structure of the monomethyl ether he obtained by direct methylation of Japanese lac are not conclusive.

During the present investigation the two isomeric monomethyl ethers of pentadecylcatechol have been isolated by means of chromatographic fractional separation from the product obtained by direct methylation. These monomethyl ethers after recrystallization melted at 43.5° (VI) and 47.0° (V) and although both of them gave an identical bluish green color reaction with neutral ferric chloride, a mixture of the two ethers gave a marked depression in their mixed melting point determination.

It was therefore necessary to synthesize by an unambiguous route one of the monomethyl ethers of pentadecylcatechol to obtain conclusive evidence for the position of the methoxy group in the monomethyl ethers isolated by direct methylation of pentadecylcatechol or via the monobenzoyl ester. Because of the availability of an appropriate aldehyde of established structure, *i.e.*, 3-methoxy-2-hydroxybenzaldehyde (*o*-vanillin), the route selected for synthesis was similar to that previously used for the synthesis of 3-pentadecyl veratrole.[12,13]

The Grignard reaction of 3-methoxy-2-hydroxybenzaldehyde (I) with myristyl bromide (II) yielded 1-methoxy-2-hydroxy-3-(1′-hydroxypentadecyl)benzene (III). Dehydration of (III) using potassium hydrogen sulfate yielded 1-methoxy-2-hydroxy-3-(1′-pentadecenyl) benzene (IV). This unsaturated monomethyl ether was hydrogenated in acetic acid solution at atmospheric pressure using 10% palladium on charcoal catalyst to give the 1-methoxy-2-hydroxy-3-pentadecylbenzene (V), melting at 46.5–46.8°.

The synthetic monomethyl ether did not show any depression in the melting point with the monomethyl ether obtained from the monobenzoyl ester used in the preparation of the monoglycoside. It may therefore be concluded that the monobenzoyl ester melting at 67.3° is 1-hydroxy-2-benzoyl-3-pentadecylbenzene and the ester melting at 61.0° is 1 - benzoyl - 2 - hydroxy - 3 - pentadecylbenzene. The monoglycoside isolated from 3-pentadecylcatechol either directly or *via* its monobenzoyl ester has the structure 1-glucosidyl-2-hydroxy-3-pentadecylbenzene.

The monomethyl ether melting at 43.5° may now be assigned the structure 1-hydroxy-2-methoxy-3-pentadecylbenzene. This monomethyl ether was also obtained *via* the monobenzyl ether of 3-pentadecylcatechol. The monobenzyl ether mixture was prepared by the action of benzyl bromide on 3-pentadecylcatechol and the 1-benzyloxy-2-hydroxy-3-pentadecylbenzene was separated and purified on an alumina column. This monobenzyl ether was methylated with dimethyl sulfate to 1-benzyloxy-2-methoxy-3-pentadecylbenzene. The benzyl ether linkage was cleaved by catalytic hydrogenation at atmospheric pressure using palladium on charcoal catalyst to give the 1-hydroxy-2-methoxy-3-pentadecylbenzene melting at 43.5°.

(11) R. Majima, *Ber.*, **53**, 1907 (1920).

(12) H. J. Backer and N. H. Haack, *Rec. trav. Chim.*, **60**, 661 (1941).

(13) D. Wasserman and C. R. Dawson, *J. Am. Chem. Soc.*, **71**, 2588 (1949).

EXPERIMENTAL

All melting points are uncorrected. Microanalyses were run by Schwarzkopf Microanalytical Laboratory, Woodside, N. Y.

3-Pentadecylcatechol. A synthetic sample obtained from the Lederle Laboratories Division of American Cyanamid Company, N. Y., was used. It was a white crystalline solid, m.p. 58.5–59.0°.

Acetobromoglucose (2,3,4,6-tetraacetyl-α-d-glucopyranosyl bromide). This compound was prepared according to the procedure in Organic Synthesis[14] and a recrystallized sample had the correct melting point of 88–89°.

Dibenzoyl ester of 3-pentadecylcatechol. A 1.6-g. sample of pentadecylcatechol was dissolved in 10 cc. of pyridine in a 25-cc. Erlenmeyer flask and the solution cooled to 0°. Benzoyl chloride (2 g.) was slowly added to the flask with slight swirling and after keeping at room temperature for 6 hr. the reaction mixture was poured into 100 cc. of dilute hydrochloric acid containing lumps of ice. A white precipitate of the dibenzoyl ester that separated was filtered, washed first with dilute HCl, then with a dilute solution of sodium bicarbonate, and finally with distilled water. This was recrystallized twice from ethyl alcohol to give white needle shaped crystals, m.p. 59.8–60.0°.

Anal. Calcd. for $C_{35}H_{44}O_4$: C, 79.52; H, 8.47. Found: C, 79.41; H, 8.52.

Monobenzoyl esters of 3-pentadecylcatechol (X and XI). 3-Pentadecylcatechol, 2.9 g. (0.0091 mole) dissolved in 15 cc. pyridine was cooled to 0° and treated with 1.4 g. (0.01 mole) of benzoyl chloride. The mixture was kept first at 0° for an hour and then at room temperature for 6 hr. The product was transferred to a separatory funnel and diluted with 100 cc. of ice cold 15% hydrochloric acid. The mixture was extracted with 50 cc. of ligroin and the ligroin extract washed successively with 20-cc. portions of dilute HCl, distilled water, dilute sodium bicarbonate solution, and distilled water. The extract was dried over anhydrous magnesium sulfate and filtered. On evaporation of the solvent, 3.85 g. of a light yellow waxy solid was obtained. This sample was fractionated in four separate batches on a chromatographic column.

The column consisted of a 25 × 350 mm. glass tube and the absorbent used was acid-washed alumina (Merck, reagent quality). The alumina was packed uniformly in the column to a height of 180 mm. (82 g.) and 1.0 g. of the above sample dissolved in 10 cc. of pentane was placed on the column. The column was developed using pentane with a nitrogen pressure of approximately 5 lb. per sq. in. The first eluent portions on evaporation of pentane gave a solid residue and the development of the column was continued until no more residue was present in the eluent samples. This required 1400 cc. of pentane. The residue obtained from the eluent portions was pure dibenzoyl ester of pentadecylcatechol (m.p. 60°) and amounted to 0.2 g.

The column was then extruded and sectioned into 9 equal parts, and each section was separately extracted with 20 cc. of ether. Evaporation of the solvent from these extracts gave yellow oily fractions, designated as fractions 1 to 9 starting from the top portion of the column, in the following yield (g.): 0.10, 0.10, 0.17, 0.13, 0.15, 0.03, 0.04, 0.01, and 0.01. Fractions 1 and 2 which were darker than the remaining fractions contained unreacted pentadecylcatechol along with some of its oxidation products. Fractions 3 to 7 were the monobenzoyl ester fractions used in subsequent chromatographic experiments. On the whole 2.1 g. of this monobenzoyl ester fraction was obtained from the original 3.85 g. of the reaction product. The small amount of material in fractions 8 and 9 was not investigated.

The above 2.1-g. sample of the monobenzoyl ester fraction was placed on a 25 × 240 mm. column of alumina and the column developed with 2 l. of pentane. There was no residue in the eluent portion. The column was extruded and sectioned into 12 equal portions and each portion extracted with 20 cc. of ether. Beginning from the top part of the column the yields (grams) of these twelve fractions were respectively 0.15, 0.23, 0.25, 0.15, 0.08, 0.07, 0.33, 0.21, 0.26, 0.05, 0.02, and 0.01. The decrease in the amount of residue in fractions 5 and 6 indicated a separation of the two isomeric monobenzoyl esters by this chromatography. Fraction 1 contained a small amount of pentadecylcatechol. Fractions 2, 3, and 4 were mixed and termed monobenzoyl ester A and fractions 7, 8, and 9 were mixed together as monobenzoyl ester B. These two fractions (A and B) were separately purified for the isolation of the isomeric monobenzoyl esters.

Isolation of 1-benzoyl-2-hydroxy-3-pentadecylbenzene (X). The monobenzoyl ester fraction A, 0.63 g. was chromatographed on a 25 × 160 mm. alumina column using 2 l. of pentane. The column was extruded and a 50-mm. section after the first 30 mm. from the top of the column was extracted with 40 cc. of ether. The ether extract was evaporated to yield 0.35 g. of a light yellow solid. This was recrystallized twice from ligroin and finally from ethyl alcohol to give a pure sample of 1-benzoyl-2-hydroxy-3-pentadecylbenzene, m.p. 60.8–61.0°.

Anal. Calcd. for $C_{28}H_{40}O_3$: C, 79.19; H, 9.49. Found: C, 79.08; H, 9.51.

Isolation of 1-hydroxy-2-benzoyl-3-pentadecylbenzene (XI). The monobenzoyl ester fraction B, 0.74 g. was chromatographed on a 25 × 160 mm. alumina column using 2 l. of pentane. In this case a 50-mm. section after the first 90 mm. from the top of the column was extracted with 40 cc. of ether and the ether solution evaporated to give 0.50 g. of a white solid. On recrystallization from ethyl alcohol this monobenzoyl ester of pentadecylcatechol melted at 67.0–67.3°. There was a distinct lowering in its melting point when mixed with the isomeric monobenzoyl ester obtained from A.

Anal. Calcd. for $C_{28}H_{40}O_3$: C, 79.19; H, 9.49. Found: C, 79.13; H, 9.55.

Preparation of 1-methoxy-2-hydroxy-3-pentadecylbenzene from XI. A sample of the monobenzoyl ester XI, 0.4 g. was methylated using 2 g. of methyl iodide and 1.5 g. of freshly prepared silver oxide.[15] After the reaction, the mixture was filtered and the filtrate diluted with 20 cc. of distilled water and extracted with ether. On removal of the solvent from the ether extract 0.35 g. of a colorless oil was obtained. Thi sample of the methyl ether benzoyl ester of pentadecylcatechol (XIII) was saponified without purification. The oil was dissolved in 20 cc. of 95% ethyl alcohol containing 0.5 g. of KOH and the solution refluxed for 1 hr. About 10 cc. of alcohol was distilled off from the reaction mixture and the remaining solution cooled, diluted with 20 cc. of distilled water, acidified with dilute HCl, and extracted with ether. The ether was evaporated and the light yellow colored oily residue, 0.15 g. was recrystallized 3 times from methanol to give white crystals of the monomethyl ether of 3-pentadecylcatechol (V) m.p. 45.5–46.0°. This sample of V gave no depression in melting point when mixed with the synthetic sample of V prepared *via* I, II, III, and IV. However, when this sample of V was mixed with the isomeric methyl ether VI (prepared directly from 3-pentadecylcatechol, see below) a depression in the melting point was observed.

Preparation of the monomethyl ethers (V and VI) *of pentadecylcatechol.* A 3.2-g. (0.01 mole) sample of the catechol in 20 cc. of methanol was methylated using 1.5 g. (0.012 mole) of dimethyl sulfate.[16] The reaction product was poured into 100 cc. of water, acidified, and extracted with 30 cc. of ether. The ether extract on evaporation gave 3.6 g. of a dark oil which was subjected to the same type of chromatographic separation as in the case of the monobenzoyl ester. The first chromatographic separation over alumina

(14) C. E. Redemann and C. Niemann, *Org. Syntheses*, Col. Vol. III, 11 (1955).

(15) A. Robertson, *J. Chem. Soc.*, 1136 (1930).

(16) J. S. Buck, *Org. Syntheses*, Col. Vol. II, 619 (1943).

using pentane yielded from the body of the column (leaving the top 2 cm. as the unreacted catechol) 1.7 g. of the monomethyl ether fraction. This material was rechromatographed and 0.3 g. of one of the monomethyl ethers was isolated from the top half of the column while 0.8 g. of the other isomer was recovered from the bottom half of the column. This second chromatographic separation was carried out in a manner similar to that used for the second chromatographic separation of the monobenzoyl esters. Recrystallization of the monomethyl ether (from the top part of the column) using ethanol gave white crystals (VI) m.p. 43.0–43.5°.

Anal. Calcd. for $C_{22}H_{38}O_2$: C, 78.98; H, 11.45. Found: C, 79.03; H, 11.52.

The 0.8 g. sample of monomethyl ether obtained from the bottom part of the column was recrystallized from aqueous ethanol to give white needle-shaped crystals (V) m.p. 46.5–47.0°.

Anal. Calcd. for $C_{22}H_{38}O_2$: C, 78.98; H, 11.45. Found: C, 78.93; H, 11.50.

A mixture of the two monomethyl ethers gave a sharp depression in the melting point.

Preparation of the monomethyl ether (VI) *of pentadecylcatechol, via the monobenzyl ether.* A 3.2-g. (0.01 mole) sample of 3-pentadecylcatechol was dissolved in 50 cc. of acetone containing 1.8 g. (0.011 mole) of benzyl bromide and 4.2 g. of powdered anhydrous potassium carbonate. The mixture after refluxing for 12 hr. was filtered and the acetone removed by distillation. The residual reddish brown liquid was poured into water and extracted with ether. The ether layer was dried and the solvent removed to give 4.1 g. of a dark oil. This oil was chromatographed on a 40 × 250 mm. alumina column with 4 l. of pentane. The eluent, on evaporation gave 0.6 g. of the dibenzyl ether of pentadecylcatechol m.p. 53.0°.[17] The bottom half of the column was extracted with ether and evaporation of the ether gave 1.6 g. of an impure specimen of one of the isomeric monobenzyl ethers of pentadecylcatechol. This was rechromatographed on a similar column as before using 2 l. of pentane. Again, the bottom half of the column was extracted with ether and the ether distilled off. The residue was recrystallized twice from methanol to give white needle-shaped crystals of the monobenzyl ether, m.p. 50.0–50.3°.

Anal. Calcd. for $C_{28}H_{42}O_2$: C, 81.90; H, 10.31. Found: C, 81.78; H, 10.43.

A 0.5-g. sample of the above monobenzyl ether in 20 cc. of methanol was methylated using dimethyl sulfate[16] to the corresponding methyl benzyl ether of pentadecylcatechol. This ether (0.4 g.) was catalytically hydrogenated in ethyl alcoholic solution using 0.3 g. of 10% palladium charcoal catalyst to cleave the benzyl ether linkage.[18] After the reduction, the mixture was filtered and the filtrate concentrated to about 3 cc. The solution was set aside in the refrigerator for a day during which crystals of the monomethyl ether VI separated. These crystals were collected and recrystallized once more from ethanol. This monomethyl ether melted at 42.5–43.0° and showed no depression in melting point when mixed with VI prepared by the direct methylation of 3-pentadecylcatechol.

Synthesis of 1-methoxy-2-hydroxy-3-pentadecylbenzene (V) *from o-vanillin.* A 3.4-g. (0.02 mole) sample of 3-methoxy-2-hydroxybenzaldehyde (*o*-vanillin) was treated with the Grignard reagent from 8.3 g. of *n*-myristyl bromide in 100 cc. of dry ether and 0.8 g. of magnesium turnings.[12] The product after hydrolysis with 2*N* sulfuric acid was crystallized from the ether solution as a light yellow solid. Recrystallization from petroleum ether yielded 6.0 g. of the expected 1-methoxy-2-hydroxy-(3-1′-hydroxypentadecyl)-benzene (III) m.p. 48–49°.

(17) B. Loev and C. R. Dawson, *J. Am. Chem. Soc.*, **78**, 4083 (1956).

(18) B. Loev, Ph.D. Dissertation, Columbia University (1952).

Anal. Calcd. for $C_{22}H_{37}O_2$: C, 75.59; H, 10.67. Found: C, 75.48; H, 10.63.

A mixture of 5 g. of III and 0.8 g. of fused potassium bisulfate was heated at 200° for about 1 hr. and cooled. The dehydrated product was extracted with ether and purified by recrystallization from petroleum ether. A light yellowish solid thus obtained had a melting point of 44–44.5° (yield 3.4 g.). This sample of 1-methoxy-2-hydroxy-3-(1′-pentadecenyl)benzene (IV) was catalytically hydrogenated in acetic acid solution using 10% palladium on charcoal catalyst at atmospheric pressure. After the hydrogenation the catalyst was removed and the acetic acid diluted with water when an oil separated. On standing at room temperature for a day the oil set to a waxy solid. This solid was recrystallized four times from ethyl alcohol to give white crystalline monomethyl ether of pentadecylcatechol, 2.5 g., m.p. 46.5–46.8°.

Anal. Calcd. for $C_{22}H_{38}O_2$: C, 78.98; H, 11.45. Found: C, 78.87; H, 11.42.

Preparation of the monoglycoside (IX) *directly from pentadecylcatechol.* Pentadecylcatechol, 2 g., was dissolved in 20 cc. of dry acetone in a 100-cc. flask fitted with a separatory funnel, a mechanical stirrer, and a reflux condenser. Ten ml. of an acetone solution containing 2.5 g. of acetobromoglucose was added to the flask followed by 5 g. of anhydrous potassium carbonate. The reaction mixture was maintained refluxing for 2 hr. with stirring. The product was poured into 100 cc. of ice cold water. A bulky precipitate containing appreciable amounts of unreacted pentadecylcatechol separated which was collected and washed with 20 cc. of ligroin at 0°. The remaining crude tetraacetyl monoglycoside (VIII), 0.3 g., was hydrolyzed, using methyl alcoholic ammonia.[8] The methanol was distilled off and the residue of brown amorphous solid was recrystallized from ethyl acetate. A constant melting point of 105.5–106° was obtained after 5 recrystallizations and the yield of the monoglycoside was 0.1 g.

Anal. Calcd. for $C_{27}H_{46}O_7$: C, 67.18; H, 9.60. Found: C, 67.10; H, 9.63.

Preparation of the monoglycoside (IX) *from the monobenzoyl ester of pentadecylcatechol.* A 0.62-g. sample of the monobenzoyl ester (XI) and 1.1 g. of acetobromoglucose were mixed with 5 cc. of quinoline and to this mixture 0.6 g. of dry "active" silver oxide was added with stirring. The resulting paste was set aside in a desiccator for 1 hr. The mixture was now extracted with 30 cc. of acetic acid and the extract poured into 150 cc. of ice-cold water. A brown solid that melted at room temperature separated. This solid was dissolved in 20 cc. of ethanol, treated with norite, filtered, and the solution concentrated to half the volume. Light brownish crystals separated on cooling. After two recrystallizations from methanol, good white crystals of the tetraacetyl glycoside, 0.8 g., melting at 57–58° were obtained.

Anal. Calcd. for $C_{42}H_{58}O_{12}$: C, 66.82; H, 7.74. Found: C, 66.83; H, 7.79.

This tetraacetyl glycoside XII, 0.6 g., was dissolved in 150 cc. of methanol, the solution saturated with ammonia at 0°, and kept in a refrigerator for 24 hr. After removal of the ammonia and methyl alcohol in a vacuum, the residue was dissolved in 5 cc. of ethanol and cooled. The crystalline monoglycoside separated and was recrystallized from ethyl acetate to give 0.3 g. of white plates, m.p. 105.5–106°.

Anal. Calcd. for $C_{27}H_{46}O_7$: C, 67.18; H, 9.60. Found: C, 67.20; H, 9.55.

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