Spring 1939

The Kolbe synthesis with alkyl ortho-xenols

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THE KOLBE SYNTHESIS WITH ALKYL ORTHO-XENOLS

by

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A Thesis

Submitted in Partial Fulfillment
of the Requirements for the Degree of
Master of Science
in the Graduate School of the
University of Richmond
June, 1939

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INTRODUCTION

The phenol series of compounds has shown marked therapeutic activity. Generally there are two types of phenols used as germicides and fungicides - (a) the very soluble type such as the resorcinols and (b) the less soluble type such as the phenylphenols and salicylic acid and its derivatives. Alkylation of phenols usually increases germicidal action as is shown in numerous patents.

Black, Shaw and Walker, J. Chem. Soc., 272, 277, (1931).
Klarmann, Gatyas and Shternov, J.A.C.S., 53, 3397, (1931).
Johnson and Hodge, J.A.C.S., 35, 1014, (1913).
Johnson and Lane, J.A.C.S., 43, 348, (1921).

A well known example is Sharpe and Dohme's patent on hexylresorcinol.

Dohme, Cox and Miller, J.A.C.S., 48, 1688, (1926).

Various alkyl derivatives of salicylic acid have been prepared for (1) their germicidal action, (2) their fungicidal action, (3) their analgesic and antipyretic properties and (4) as food preservatives. Some have been patented.

Brusch, C.A., 30, P821[1] - U.S. 2,022,185, (1936).
Vorozhtsov and Troschenko, C.A., 32, 7907[3], (1938).

Kolloff and Page, J.A.C.S., 60, 948-9, (1938).

F. Hoffmann, La Roche & Co., C.A., 23, P1217[8], Swiss 127,649, (1929).

Britton, C.A., 25, P5249[4], U.S. 1,812,856, (1931).

Kropp, C.A., 19, P1615[3], U.S. 1,529,704, (1925).

The outstanding germicidal properties of o-xenol (o-phenylphenol) have been demonstrated by C. Fuller. In addition he has shown that it is non-toxic.

C. Fuller, J. Ind. & Eng. Chem., 26, 946, (1934).

Slotta and Nold, in Germany, have synthesized the 2-phenyl-4-carboxylic acid of phenol in their search for

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Slotta and Nold, C.A., 32, 7907[3], (1938).

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a new food preservative. This work was done because esters of p-hydroxy benzoic acid are used for preserving food.

Sabalitschka, C.A., 28, 3836[6], 3086[3], (1934).

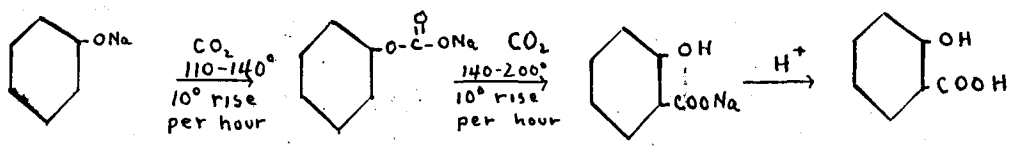
Three considerations led to the preparation of the 3-phenyl-5-alkyl salicylic acids. They were: (1) o-xenol itself is such an active bactericide, (2) alkylation of o-xenol in the number 4 position increases its germicidal action and (3) salicylic acid and some of its derivatives

and homologues have valuable medicinal properties. It was with the hope of combining the properties of the alkylated o-xenols with those of salicylic acid that this work was undertaken. The tests for the bactericidal and fungicidal properties of the 3-phenyl-5-alkyl salicylic acids and the tests for the analgesic properties of their acetyl derivatives are to be made in the near future.

HISTORY

Salicylic acid was first prepared by Piria in 1838 by oxidation of salicylaldehyde with molten potassium hydroxide. In 1843 Cahours proved that naturally occurring oil of wintergreen consisted almost entirely of the methyl ester of salicylic acid. Salicylic acid was next prepared by Gerland in 1853 from anthranilic acid by reaction with nitrous acid.

In 1860 H. Kolbe and Lautemann prepared salicylic acid from phenol, sodium and carbonic acid. It was Kolbe who first recognized that salicylic acid was a monobasic acid and he also discovered the famous Kolbe synthesis in which carbon dioxide is passed over hot, dry sodium phenate.



According to C.H. Sluiter, the resulting compound has the

C.H. Sluiter, Vught. Ber., 45, 3008-10, (1912).

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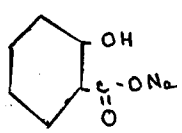
following structural configuration:



The separation of hydroxy acids from phenols with sodium bicarbonate strongly supports this theory. Recently Silin and Moshchenskaya have shown that the mechanism of the

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Silin and Moshchenskaya, C.A., 33, 1306[4], (1939).

Kolbe synthesis with β-naphthol is much more complicated than with phenol.

R. Schmidt discovered the conversion of sodium phenocarbonate under pressure at 120-130 degrees C. into monosodium salicylate. It has been shown, however, that the rearrangement of the CO_2 group takes place at 140 degrees C. and not at 120-130 degrees C. as Schmidt thought. This is an important factor in the commercial production of salicylic acid, since a considerable amount of the p-hydroxy acid is formed if the maximum pressure is not reached before the rearrangement takes place. Another commercial method of preparation was patented by Pomilio. This process con-

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Pomilio, C.A., 11, P1794[6]-Brit. 103,739, (1917).

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sisted of the electrolytic oxidation of cresols in caustic alkali solution. Recrystallization from hot water is used here for purification. Another method of purification used commercially by Everitt & Co. consists of taking the crude

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Everitt and Jackson, C.A., 11, P2263[6]-Brit. 105,613, (1917).

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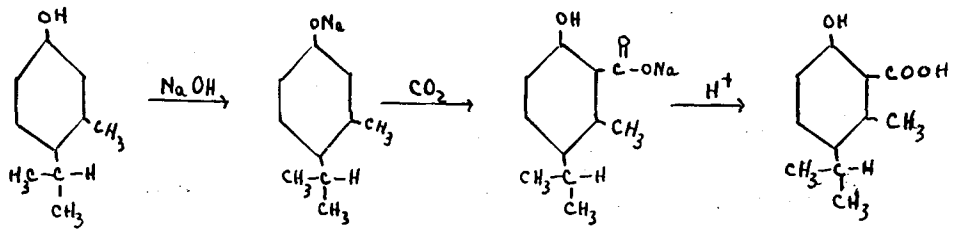
sodium salicylate solution, making it faintly acid and passing it, while hot, over zinc and decolorizing charcoal. More acid is added until the salicylic acid is completely precipitated. It is then separated, washed and dried.

There are many substituted hydroxy acids offered on the market for use as antiseptics, germicides, fungicides, food preservatives and disinfectants. Most of these find their greatest value by virtue of their increased insolubility over the hydroxy acids. The hydroxy acids are too soluble in water and are washed away from the source of infection before they can react adequately on the infecting agent. The o-hydroxy acids are generally more effective antiseptics and fungicides than the p-hydroxy acids. For food preservatives, however, the latter series of compounds possesses the better bactericidal properties.

A product reported to have antirheumatic and analgesic properties is 5-isopropyl-6-methyl salicylic acid which is prepared according to the following reaction:

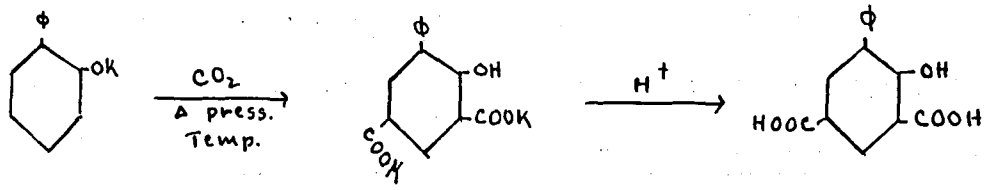


This product is purified by recrystallization from benzene.

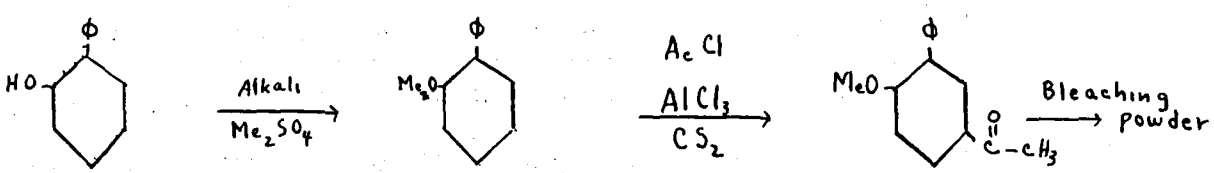
In Germany, Slotta and Mold, in an attempt to prepare

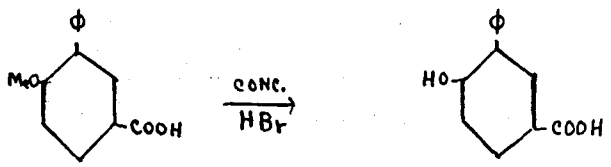
Slotta and Mold, C.A., 32, 7907[3], (1938).

2-phenyl-3-carboxy phenol, prepared 2-phenyl-1,6-dicarboxy phenol.



They finally succeeded in preparing 2-phenyl-4-carboxy phenol by the following synthesis:





This was prepared in the hope of obtaining a suitable bactericide to be used as a food preservative.

E. Britton, on August 9, 1938, patented a method for

Britton, C.A., 32, P7023[3] - U.S. 2,126,610, (1933).

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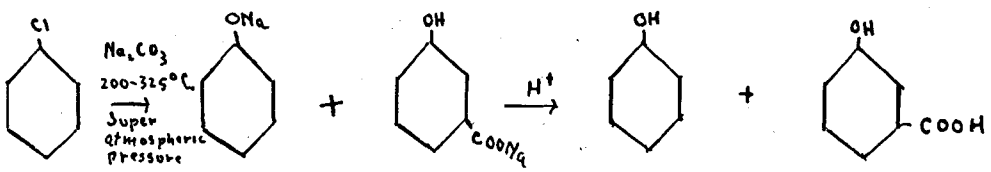
preparing hydroxy carboxylic acids and phenols at the same time. In this reaction chlorobenzene is heated with sodium carbonate under pressure.



In the commercial preparation of carbolic acid by hydrolysis of chlorobenzene with sodium hydroxide at high pressure considerable amounts of 2-hydroxybiphenyl and 4-hydroxybiphenyl were formed. In a search for uses for these compounds and their derivatives, N.N. Voroshtsov, Jr. and A.T. Troschenko prepared 3-phenyl salicylic acid by

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Voroshtsov and Troschenko, C.A., 32, 7907^3, (1938).

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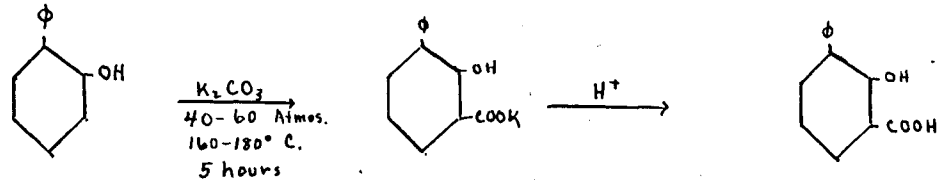
heating 2-hydroxybiphenyl with potassium carbonate and carbon dioxide under pressure.



L. Claisen found that by heating certain allyl ethers

Claisen, Ber., 45, 3157-66, (1912).

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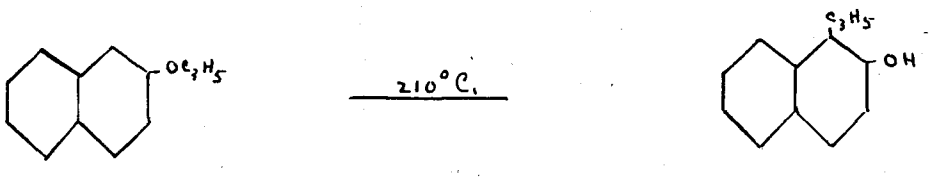
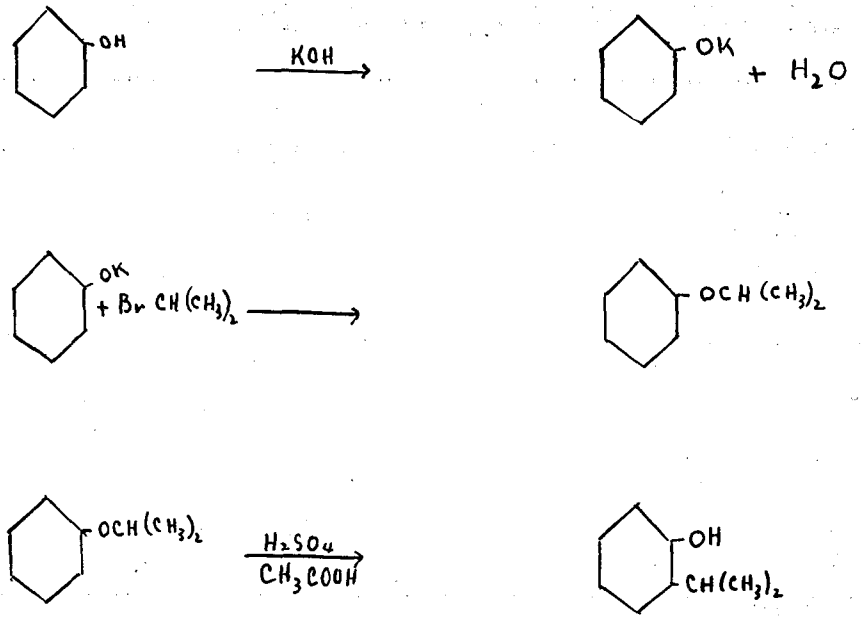
of phenols, such as α-naphthol ether, to about 210 degrees C. that complete conversion to the allyl phenol took place.



Branched alkyl radicals are often attached to the benzene

Niederl and Natelson, J.A.C.S., 53, 1928, (1931).

nucleus by addition of the alkyl bromide to potassium phenate and rearrangement of the alkyl group with a mixture of glacial acetic and sulfuric acids.



In a patent issued to the Resinous Products and Chemical Co., sulfuric acid is used as a condensing agent for phenol with a non-aromatic, mono-hydric alcohol or

Brunson, C.A., 29, P3875- U.S. 1,998,750, (1935).

olefin containing 5-7 carbon atoms. Croxall, Sowa and Nieuw-

Croxall, Sowa and Nieuwland, J.A.C.S., 56, 2054, (1934).

land extended the application of this reaction to include propylene by using boron fluoride as a catalyst. Dohme, Cox

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Dohme, Cox and Miller, J.A.C.S., 48, 1690, (1926).

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and Miller introduced the alkyl group into resorcinol by the following method: Resorcinol was added to a mixture of anhydrous zinc chloride and a fatty acid with stirring and heating. The resulting ketone was reduced by the Clemmenson method to the alkyl resorcinol.

In the alkylation of o-xenol, Harris and Christiansen

Harris and Christiansen, J. Am. Pharm. Assoc., 23, 530-6, (1934).

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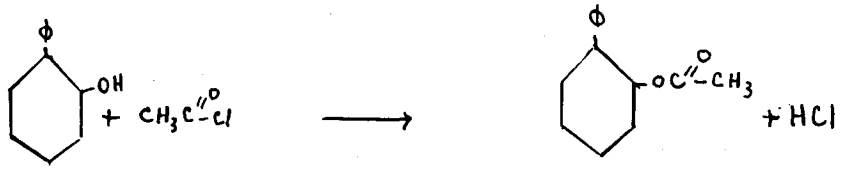
acylated o-xenol and rearranged the resulting compound by the Fries rearrangement, which employs aluminum chloride as a catalyst, and reduced the resulting ketones by the method of Clemmenson.

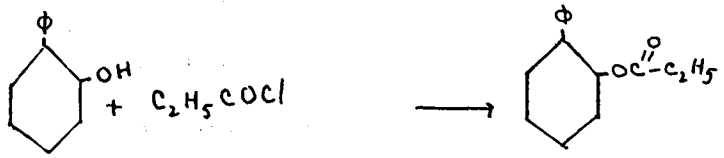
EXPERIMENTAL

ACETYL O-XENOL Eighty-five grams of o-xenol (0.5 mole) were treated with 48 ml. of acetyl chloride (0.67 mole) in a 500 ml. Kjeldahl flask. The reaction mixture was allowed to stand for at least 12 hours with a drying tube ($CaCl_2$) at the mouth of the flask. Five ml. of acetyl chloride were added and the flask was heated on the water bath for one hour. The reaction mixture was poured into a beaker of cold water with vigorous stirring. The acetyl-o-xenol was filtered off with suction, washed with water and allowed to dry for one day on a paper towel. It was crushed in a mortar and allowed to stand at least another half day on a clean paper towel. The yield was 95% of theoretical.



PROPIONYL-O-XENOL Eighty-five grams of o-xenol (0.5 mole) were treated with 32 ml. of propionyl chloride (0.5 mole) in a 500 ml. Kjeldahl flask. The reaction mixture was allowed to stand for at least 12 hours with a drying tube ($CaCl_2$) at the mouth of the flask. Five ml. of propionyl chloride were added and the flask was heated on a water bath for one hour. The reaction mixture was cooled and poured into a separatory funnel with 25-50 ml. of di-ethyl ether, and was washed once with 15 grams of potassium

bicarbonate in 200 ml. of water and once with water. The ether solution was dried with calcium chloride and filtered, and the ether was evaporated on a hot plate. The yield was 90% of theoretical.

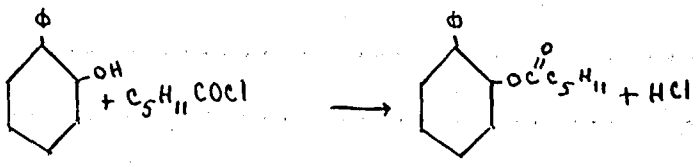


CAPROYL CHLORIDE One hundred twenty-five ml. of caproic acid (1 mole) were treated with 38 ml. (1+ moles) of phosphorous trichloride in a 500 ml. round bottom flask. The flask was connected to a reflux condenser and was heated for one hour on a water bath. The reaction was cooled in ice water (without agitation) and the caproyl chloride was poured off leaving the viscous phosphorous acid at the bottom of the flask. The yield was 80-85% of theoretical. The boiling point was 147-151 degrees C.

$$3C_5H_{11}COOH + PCl_3 \longrightarrow 3C_5H_{11}COCl + P(OH)_3$$

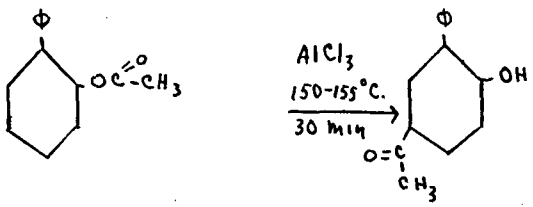
CAPROYL-O-XENOL Sixty-five grams of o-xenol (0.4 mole) were treated with 55 ml. of caproyl chloride (0.4 mole) in a 500 ml. Kjeldahl flask. Then the flask was heated on a water bath for one hour. The reaction mixture was cooled and poured into a separatory funnel with 25-50 ml. of di-ethyl ether and was washed once with 10 grams of potassium bicarbonate in 200 ml. of water and once with water. The ether solution was dried with calcium chloride

and filtered, and the ether was evaporated off on a hot plate. The yield was 90% of theoretical.



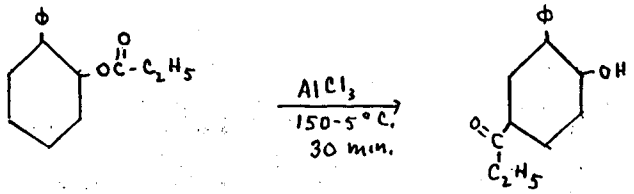
P-ACETYL-O-XENOL Sixty-one grams of acetyl-o-xenol (0.3 mole) were mixed intimately with 63 grams of aluminum chloride (0.47 mole) in a beaker. The beaker was placed in an oil bath and the temperature was raised (hood) to 80 degrees C. The vigorous reaction which took place was allowed to continue for 10-15 minutes. Then the temperature was raised to 150-155 degrees C. and kept there for one-half hour. During the initial part of this reaction the mixture was stirred well. As the reaction mixture began to set it was stirred less frequently. As it cooled it solidified, forming a glassy mass. Finally it was crushed in a mortar and was added, with stirring, to crushed ice and 5% hydrochloric acid in order to dissolve the aluminum salt. The reaction mixture was heated on a water bath to complete the solution. It was then cooled. Solid sodium hydroxide was added with stirring until the solution was strongly basic. The solid matter was allowed to settle to the bottom and was broken up with a flattened stirring rod. The solution was filtered. The filtrate was then acidified with concentrated hydrochloric acid and the precipitate of p-acetyl-o-xenol was filtered with suction and washed with

water. The product was tested for o-xenol by adding iodine in potassium iodide solution. The positive test is a purplish-red precipitate. No positive test was obtained. The yield was 80% of the theoretical.



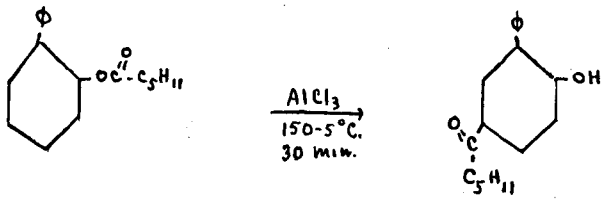
PROPIONYL-O-XENOL Sixty-eight grams of propionyl-o-xenol (0.3 mole) were mixed intimately with 74 grams of aluminum chloride in a beaker until a thick paste was formed. The beaker was placed in an oil bath and the temperature was raised (hood) to about 120 degrees C. The vigorous reaction was allowed to continue for 10-15 minutes. Then the temperature was gradually raised to 150-155 degrees C. and kept there for one-half hour. During the initial part of this reaction the mixture was stirred well. As the reaction mixture began to set it was stirred less frequently. As it cooled it solidified, forming a glassy mass. Finally it was crushed in a mortar and was added, with stirring, to crushed ice and 5% hydrochloric acid. The reaction mixture was heated on a water bath until the aluminum salt was completely dissolved. It was then cooled, and ice and solid sodium hydroxide were added, with stirring, until the solution was strongly basic. The solid matter was allowed to settle to the bottom and was broken up with a flattened stirring rod and the solution was filtered.

The filtrate was acidified with concentrated hydrochloric acid and the precipitate of p-propionyl-o-xenol was filtered off with suction and washed with water. The product was tested for o-xenol with iodine in potassium iodide solution as described above. No positive test was obtained. The yield was 78% of theoretical.

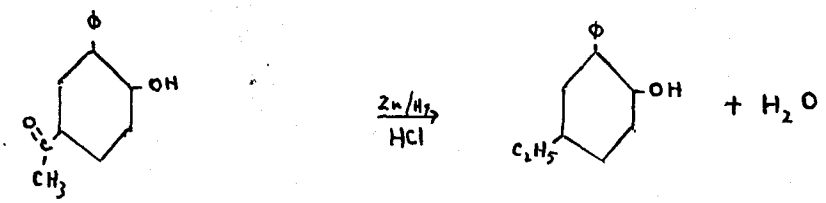


P-CAPROYL-O-XENOL Twenty-two grams of caproyl-o-xenol (0.1 mole) were mixed intimately in a beaker with 19 grams of aluminum chloride (0.15 mole). The mixture was stirred for 5 minutes. Then the beaker was placed in an oil bath and the temperature was raised (hood) to about 120 degrees C. The vigorous reaction which first took place was allowed to continue for 10-15 minutes and then the temperature was gradually raised to 150-155 degrees C. and kept there for one-half hour. During the initial part of the reaction the mixture was stirred well. As the reaction mixture began to set it was stirred less frequently. As it cooled it solidified, forming a glassy mass. Finally, it was crushed in a mortar and was added, with stirring, to crushed ice and 5% hydrochloric acid in order to dissolve the aluminum salt. The reaction mixture was heated on a water bath until the aluminum salt was completely dissolved. It was then cooled and ice and solid sodium hydroxide were

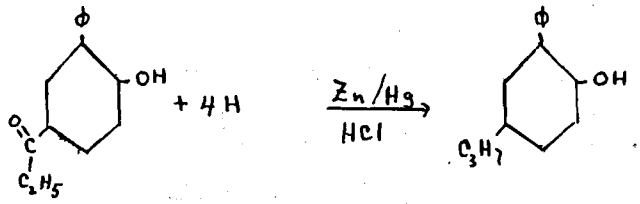
added, with stirring, until the solution was strongly basic. The solid matter was allowed to settle to the bottom and was broken up with a flattened stirring rod. The reaction mixture was filtered and the filtrate was acidified with concentrated hydrochloric acid. The precipitate of p-caproyl-o-canol was filtered with suction and washed with water. The product was tested with iodine in potassium iodide solution. No positive test was obtained. The yield was 80% of theoretical.



P-ETHYL-O-XENOL Fifty-one grams of p-acetyl-o-xenol were refluxed with 600 ml. of 20% hydrochloric acid, 80 grams of zinc amalgam, and 25 ml. of glacial acetic acid until a light oily liquid was obtained. This required from 18-20 hours. During the course of reaction 77 grams of zinc amalgam and 15 ml. of concentrated hydrochloric acid were added. The oily layer was extracted with benzene from the aqueous layer and washed once with 200 ml. of water. The benzene solution was dried with calcium chloride and the benzene was evaporated in a vacuum, and the product was distilled. The boiling point was 142-145 degrees C. at 1.4 mm. pressure. The yield was 50% of theoretical.

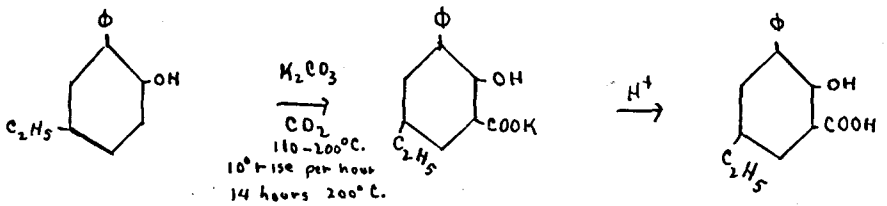


P-PROPYL-O-XENOL Fifty-one and one-half grams of p-propionyl-o-xenol were refluxed with 600 ml. of 20% hydrochloric acid, 200 grams of zinc amalgam and 25 ml. of glacial acetic acid until a light oily liquid was obtained. This required from 18-20 hours. During the course of the reaction 15 ml. of concentrated hydrochloric acid were added. The oily layer was extracted from the aqueous layer with benzene. The benzene solution was washed with 200 ml. of water. The benzene solution was dried with calcium chloride and the benzene was evaporated in a vacuum, and the product was distilled. The boiling point was 186 degrees C. at 30 mm. The yield was 48% of theoretical.



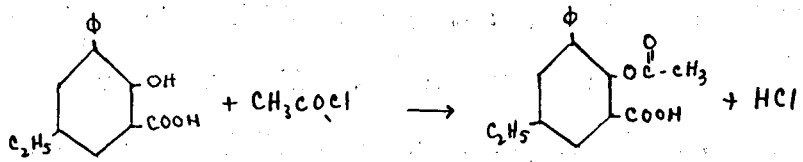
3-PHENYL-5-ETHYL SALICYLIC ACID Five grams of p-ethyl-o-xenol were mixed intimately with 33 grams of anhydrous potassium carbonate and the mixture was placed quickly in a steel tube of 250 ml. capacity. The tube was sealed quickly to prevent absorption of moisture. Eighteen grams of solid carbon dioxide were weighed out roughly. The tube was opened, the dry ice was dropped into it and it was sealed immediately. The tube was placed in the furnace at 110 degrees C. The temperature was then raised 10 degrees C. per hour until 200 degrees C. was reached. Then the tube was kept at 200 degrees C. for 14 hours. It was allowed to

cool and its contents were emptied into a beaker. One hundred seventy-five ml. of water were added to the powder and the mixture was stirred until all the potassium carbonate was dissolved. Then concentrated hydrochloric acid was added slowly until the solution was definitely acidic. The mixture was cooled in a pneumatic trough. The solid was separated by filtration and was dried on a porous plate. The crude product was recrystallized twice from a large volume of acetic acid and water (5.5:8) using decolorizing charcoal to remove impurities. The product crystallized from the acetic acid and water as white needles. The melting point was 165.5 degrees C. and the yield was 46% of theoretical.



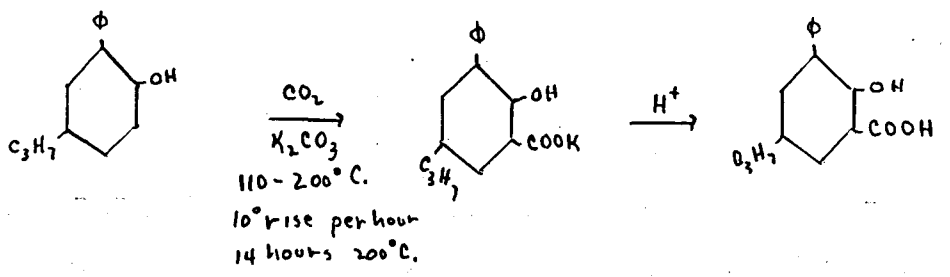
ACETYL-3-PHENYL-5-ETHYL SALICYLIC ACID To 0.3 grams of 3-phenyl-5-ethyl salicylic acid in a test tube were added 5 drops of glacial acetic acid and 50 drops of acetyl chloride. The test tube was sealed with a cork stopper having a capillary extending from it. The test tube was placed in a water bath which was heated gradually to 48 degrees C. This temperature was maintained until vigorous evolution of hydrochloric acid ceased - about one-half to three-quarters of an hour. The temperature was raised gradually to 60 degrees C. until the reaction was complete

(5-10 minutes). Then the temperature was raised to 70 degrees C. Suction was applied to remove the last traces of acetyl chloride. The test tube was cooled with ice water and the product was dissolved in ethyl alcohol. Ice water was added until the product was precipitated. The acetyl-3-phenyl-5-ethyl salicylic acid was filtered and dried on a porous plate. It sinters at 145.5 degrees C. and melts at 150.5 degrees C.



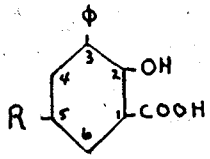
5-PHENYL-5-PROPYL SALICYLIC ACID Ten grams of p-propyl-o-xenol were mixed intimately with 65 grams of anhydrous potassium carbonate and the mixture was placed quickly in a steel tube of 250 ml. capacity. The tube was sealed quickly to prevent absorption of moisture. Eighteen grams of solid carbon dioxide were weighed out roughly. The tube was opened, the dry ice was dropped into it and it was sealed immediately. The tube was placed in the furnace at 110 degrees C. The temperature was then raised 10 degrees C. per hour until 200 degrees C. was reached. The tube was kept at 200 degrees C. for 14 hours. It was allowed to cool and its contents were emptied into a beaker. One hundred seventy-five ml. of water were added to the powder and the mixture was stirred until all the potassium carbonate was dissolved. Then concentrated hydrochloric acid was added

slowly until the solution was definitely acidic. The mixture was cooled in a pneumatic trough. The solid was separated by filtration and was dried on a porous plate. The crude product was recrystallized twice from a large volume of acetic acid and water (1:14) using decolorizing charcoal to remove impurities. The melting point was 140 degrees C. and the yield was 11% of theoretical.



DISCUSSION OF RESULTS

The 3-phenyl-5-alkyl salicylic acids are represented by the following formula, in which R may be any alkyl radical:



In connection with this work the ethyl, propyl and hexyl radicals were used.

The method employed in synthesizing this series of compounds consisted of the preparation of the alkyl-o-xenols, generally following the method of Harris and Christiansen.

Harris and Christiansen, J.Am. Pharm. Assoc., 23, 530-6, (1934).

The modification of the Kolbe synthesis used by Vorozhtsov and Troschenko, was found to work very well with

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Vorozhtsov and Troschenko, C.A., 32, 7907[3], (1934).

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the alkyl-o-xenols.

The acylation of o-xenol ran very smoothly, yielding up to as much as 95% of theoretical. The preparation of the p-acetyl-o-xenol went smoothly when 1.3 moles of aluminum chloride were used for 1 of acetyl-o-xenol. This was in accordance with the directions given by Klarmann in the

Klarmann, U.S. Patent #2,010,595, (1935).

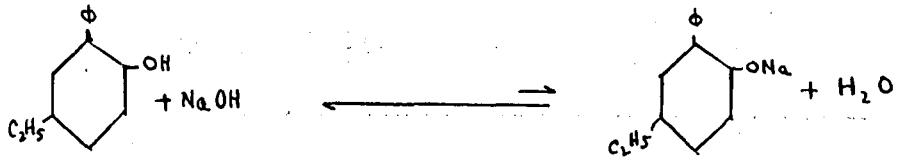
patent for the preparation of the mono-alkyl chloro-phenols.

In the preparation of p-propionyl-o-xenol, the method of Harris and Christiansen was followed, using 1.1 moles of aluminum chloride to 1 of propionyl-o-xenol. Much decomposition took place and when the product was recrystallized from ethyl alcohol and water a red resinous solid was left which melted at 120-123 degrees C. The decomposition product was found to be insoluble in ammonium hydroxide and this proved to be a fairly good method of purification, since the p-acyl-o-xenols are soluble in ammonium hydroxide. However, when the amount of aluminum chloride was increased to 1.5 moles per mole of propionyl chloride there was no decomposition.

One of the greatest difficulties encountered was in the reduction of the p-acyl-o-xenols. The best yield that could be obtained was not more than 50%. When the product was distilled under reduced pressure a large amount of resinous material was left. This was similar to the residue described by Harris and Christiansen. There was also a considerable amount of unreduced ketone left, in spite of the fact that the reduction was continued for 24 hours.

Many methods were tried for the introduction of the carboxyl group into p-ethyl-o-xenol, but all failed probably because of the difficulty of obtaining anhydrous

conditions. The first reaction tried was the regular Kolbe synthesis in which the sodium salt of the phenol was made by adding sodium hydroxide in water and evaporating to dryness. Much decomposition took place, and after putting the resulting compound in a steel tube with dry ice and heating at 110-200 degrees C., no product was obtained with properties corresponding to the desired hydroxy acid. This was probably due to the equilibrium formed thus:



Hence, upon evaporation of the water from the solution, a small amount of the sodium salt of p-ethyl-o-xenol and a large amount of sodium hydroxide and the phenol were obtained. p-Ethyl-o-xenol is not stable when heated in basic solution. Therefore the phenol decomposed when the water was evaporated.

A procedure similar to the one described above was tried using ethyl alcohol and metallic sodium instead of water and sodium hydroxide, but decomposition set in as the solution approached dryness.

The results of Slotta and Nold showed the potassium

Slotta and Nold, C.A., 30, 2944[4], (1936).

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salt to be very effective in the Kolbe synthesis. There-

fore p-ethyl-o-xenol and metallic potassium were dissolved in absolute alcohol. The two solutions were combined and the alcohol was evaporated. On carboxylation this compound yielded a small amount of the desired acid. Then in an effort to increase the yield, the solution containing potassium ethylate and p-ethyl-o-xenol in absolute alcohol was evaporated in a vacuum from pumice in the steel tube. The purpose of the pumice was to give more surface for the reaction of the carbon dioxide with the sodium salt of p-ethyl-o-xenol. This increased the yield slightly but it was still only about 2% of theoretical.

At this point the need for a method of purification of the hydroxy acid became evident. The usual method of separation of phenols from hydroxy acids with sodium bicarbonate did not work. Precipitation of the calcium and iron salts did not give a clean separation. The solubility of the hydroxy acid in ammonium hydroxide proved to

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Suggested by J.M. Salsbury, U. of Richmond, 1940.

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be a fairly good method of separation until the yield rose to about 20% of theoretical. Then the amount of ammonium hydroxide necessary to dissolve the product became large enough to dissolve the phenol also.

The best method found for preparing the 3-phenyl-5-alkyl salicylic acids has been a modification of the preparation of 2-hydroxybiphenyl-3-carboxylic acid by Voroshtsov

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Voroshtsov and Troschenko, C.A., 32, 7907[3], (1938).

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and Troschenko. In this method potassium carbonate is mixed intimately with the phenol. A large excess of potassium carbonate over the amount suggested by these workers is used. This results in a greater yield, due to the increased surface of potassium carbonate available for the reaction.

The best method found for purification of 3-phenyl-5-ethyl salicylic acid is recrystallization from a large volume of acetic acid and water (5.5:8) using decolorizing charcoal. The product of the first recrystallization melts at 162 degrees C. After a second recrystallization it melts at 165.5 degrees C.

SUMMARY

I The following compounds were prepared:

acetyl-o-xenol

propionyl-o-xenol

caproyl chloride

caproyl-o-xenol

p-acetyl-o-xenol

p-propionyl-o-xenol

p-caproyl-o-xenol

p-ethyl-o-xenol

p-propyl-o-xenol

II The following new compounds were prepared:

3-phenyl-5-ethyl salicylic acid

3-phenyl-5-propyl salicylic acid

acetyl 3-phenyl-5-ethyl salicylic acid

III It is intended that 3-phenyl-5-alkyl salicylic acids be tested for germicidal and fungicidal activity while their acetyl derivatives will be tested for their analgesic properties.

ACKNOWLEDGEMENT

I wish to express to Dr. J.S. Pierce my sincere appreciation for his assistance, suggestions and guidance during this work.

My appreciation also goes to Dr. E.E. Reid for his suggestions and encouragement.

I wish to thank Dr. A.I. Whitenfish for his suggestions concerning the physico-chemical aspects of this problem.

AUTOBIOGRAPHY

I, Sidney Harris, was born in Paterson, New Jersey on February 9, 1917. In September, 1923 I entered Public School #21 in Paterson. Upon graduating from Public School #20 in 1931, I entered Eastside High School of Paterson, graduating in February, 1935. The first two years of my undergraduate college career were spent at New York University (Heights), and the remainder at the University of Richmond, where in June, 1938, the degree of Bachelor of Science was conferred on me. In September, 1938 I was awarded a service scholarship at the University of Richmond, on which I am now completing the requirements for the degree of Master of Science.

May, 1939