and by Oliverio and Casinovi.[6] Thus there is no doubt about the proposed structural formula.

EXPERIMENTAL

Isolation of nobiletin. Orange peel juice was obtained from the peel oil centrifugals which were operated in connection with a frozen concentrate plant. Peel from the orange juice extractors passed directly through grooved rolls which expressed an emulsion of peel oil and the aqueous peel juice. After screening to remove peel fragments, the emulsion was fed directly to the centrifugals which separated part of the oil.

Juice so obtained was filtered in the laboratory with a diatomaceous filter aid on precoated Büchner funnels. The filtrate was extracted once with petroleum ether (b.p. 60–68°) to remove any remaining peel oil and adjusted to *p*H 8.0 with sodium hydroxide pellets. The alkaline mixture was then extracted batchwise with carbon tetrachloride, using two 50-ml. portions to each 1.5-l. portion of juice. The combined extracts were then concentrated *in vacuo* nearly to dryness and the residue was dissolved in hot methanol. After treatment with a small quantity of decolorizing carbon, the hot solution was filtered and allowed to crystallize. The precipitate was repeatedly recrystallized from methanol to a constant melting point of 137–138° cor. The yield was quite small, 4.7 g. nobiletin being obtained from about 250 l. of peel juice.

The ultraviolet spectrum was determined in 95% ethanol solution. The locations of the maxima and corresponding log ϵ values were as follows: 210 mμ (4.627), 248 mμ (4.341), 271 mμ (4.283), 333 mμ (4.449).

Anal. Calcd. for $C_{21}H_{22}O_8$: C, 62.68; H, 5.51; —OCH_3, 46.28. Found: C, 62.95, 63.05; H, 5.67, 5.72; —OCH_3, 46.34, 46.29. Nobiletin is tasteless in the crystalline form, probably because of its slight solubility. Alcoholic solutions diluted with water are quite bitter.

Hydrolysis of nobiletin. A 2.0-g. portion of nobiletin was refluxed with a mixture of 100 ml. of ethanol and 100 ml. of 20% aqueous potassium hydroxide for 6 hr. The mixture was concentrated at atmospheric pressure to half its volume and 100 ml. of water were added. Carbon dioxide was bubbled into the mixture until it was saturated. An ether extraction of the neutral products of hydrolysis was then made and reserved for the isolation of acetoveratrone. The aqueous residue was also retained for the isolation of the acidic hydrolysis products.

Isolation of acetoveratrone oxime. The ethereal extract of the neutral hydrolysis products was evaporated nearly to dryness. To this was added a mixture containing 0.5 g. of hydroxylamine hydrochloride and 4 ml. of 5% sodium hydroxide and enough ethanol to give a clear solution. After heating for 10 min. in a hot water bath, the mixture was cooled and placed in a cold room at 4°. A yield of 0.23 g. of crystals melting at 141° cor. was obtained which agrees with that reported by Robinson and Tseng[3] for acetoveratrone oxime.

Anal. Calcd. for $C_{10}H_{13}O_3N$: C, 61.55; H, 6.66; —OCH_3, 31.80; N, 7.18. Found: C, 61.98, 61.74; H, 6.65, 6.72; —OCH_3, 31.24, 31.09; N, 6.76, 6.80.

Acidic hydrolysis products. Veratric acid. The aqueous residue remaining after the extraction of the neutral hydrolysis products was acidified with dilute sulfuric acid and extracted again with ether. The ether was removed by evaporation and the residue weighing 1.4 g. was twice crystallized from about 70 ml. water. After drying, the melting point was found to be 182° cor. A mixture with anisic acid gave a melting-point depression of 30°, thus excluding this as a possibility. Analysis and a neutral equivalent determination were in agreement with those of veratric acid. The yield was 0.4 g. The amide melted at 164–166°, which is in agreement with the values given in the literature for veratric acid.

Anal. Calcd. for $C_9H_{10}O_4$: C, 59.33; H, 5.53; —OCH_3, 34.07; Neut. equiv., 182.2. Found: C, 59.56, 59.67; H, 5.70, 5.68; —OCH_3, 34.26, 34.34; Neut. equiv., 185.1.

Acknowledgment. The author is indebted to L. E. Brown of the Southern Regional Research Branch, ARS, for the elemental analyses.

FRUIT AND VEGETABLE PRODUCTS LABORATORY
SOUTHERN UTILIZATION RESEARCH AND DEVELOPMENT DIVISION
AGRICULTURAL RESEARCH SERVICE
U. S. DEPARTMENT OF AGRICULTURE
WINTER HAVEN, FLA.

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[6] A. Oliverio and C. Casinovi, *Gazz. Ital.*, **80**, 798 (1950); *Chem. Abstr.* **46**, 977 (1952).

Reaction of Cyclic Sulfites of 1,3-Glycols with Sodium Iodide

STANLEY WAWZONEK AND J. T. LOFT[1]

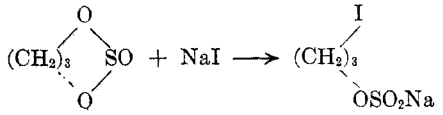
Received February 22, 1960

Alkyl sulfites have not been studied extensively as alkylating agents because of the ease of preparation and reactivity of the corresponding sulfates and sulfonates.

Cyclic sulfites of 1,3-glycols which are much more readily available than the cyclic sulfates have not been studied in this respect. Their behavior as alkylating agents would offer a convenient route to 3-monosubstituted derivatives of 1-propanol.

In this work the reaction of sodium iodide with the sulfites of trimethylene glycol, 3,3-bishydroxymethyloxetane, pentaerythritol, 3,3-dimethyl-1,3-propanediol, and 3-methyl-3-hydroxymethyl-1,3-propanediol has been studied and found to proceed normally with the first three compounds; 3-iodo-1-propanol, 3-hydroxymethyl-3-iodomethyloxetane, and 2,2-bisiodomethyl-1,3-propanediol were obtained, respectively.

The reaction was carried out in methyl ethyl ketone and found to proceed in a similar fashion to that found by others[2] for the reaction of sodium iodide with alkyl sulfites in acetone. Simultaneous condensation of methyl ethyl ketone apparently occurs with the liberation of water and subsequent hydrolysis of the intermediate sulfite. The methyl ethyl ketone bisulfite addition compound in contrast to the findings of Foster, *et al.*[2] coprecipitated



I II

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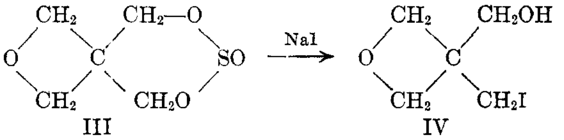
[1] Abstracted in part from the Ph.D. thesis of J. T. Loft, August 1959.

[2] A. B. Foster, E. B. Hancock, W. G. Overend, and J. C. Robb, *J. Chem. Soc.*, 2589 (1956).

with sodium iodide during the reaction. The alkylation in the presence of water was found to cause the precipitation of sodium bisulfite instead and to increase the yield of 3-iodo-1-propanol in the reaction of trimethylene sulfite (I) with sodium iodide. A similar addition of water to a solution of pentaerythrityl disulfite and sodium iodide in methyl ethyl ketone was deleterious, as the alkylation reaction was slower and hydrolysis of the sulfite to pentaerythritol occurred.

The structure of 3-hydroxymethyl-3-iodomethyloxetane (IV) obtained from 2,4,8,3-trioxathiaspiro-[5,3]nonane-3-oxide (III)[3] was indicated by its elemental analysis and its infrared spectra.



The sulfite of 2-methyl-2-hydroxymethyl-1,3-propane-diol[3] required methyl isopropyl ketone as a solvent to effect a reaction. The reaction proceeded normally but the product, 2-methyl-2-hydroxymethyl-3-iodo-1-propanol was isolated as a 1:1 complex with 2-methyl-2-hydroxymethyl-1,3-propanediol. Dissociation of the complex occurs in acetone since after five crystallizations from this solvent 2-methyl-2-hydroxymethyl-1,3-propanediol could be obtained in pure condition.

The sulfite of 2,2-dimethyl-1,3-propanediol was resistant to alkylation and after refluxing with sodium iodide in methyl isopropyl ketone for forty-eight hours gave very little product. The stability of this cyclic sulfite is no doubt brought on by the *gem* methyl groups.

EXPERIMENTAL[4]

3-Iodo-1-propanol. A solution of 1,3,2-dioxanthiane-2-oxide[5] (24.4 g.), sodium iodide (30 g.), and water (3.6 g.) in methyl ethyl ketone (300 ml.) was refluxed for 24 hr. and formed a light yellow precipitate. The entire mixture was dried with anhydrous sodium sulfate and filtered. Fractional distillation under nitrogen gave 24.5 g. of 3-iodo-1-propanol boiling at 112° (31 mm.); n_D^{20} 1.5515; d_4^{25} 2.014. The literature[6] reports a boiling point of 115° (38 mm.) and a refractive index of n_D^{20} 1.5585.

Anal. Calcd. for C_3H_7OI: C, 19.38; H, 3.79. Found: C, 19.42; H, 3.58.

3-Hydroxymethyl-3-iodomethyloxetane (IV). 2,4,8,3-Trioxathiaspiro[5,3]nonane-3-oxide[3] (III) (10 g.) and sodium iodide (14.2 g.) were refluxed in methyl ethyl ketone for 20 hr. The solution was filtered, then acidified with dilute hydrochloric acid and separated from the water layer. Removal of the methyl ethyl ketone gave an oil which distilled at 128° (2 mm.); yield, 2.6 g.; n_D^{24} 1.5603.

Anal. Calcd. for $C_5H_9O_2I$: C, 26.31, H, 3.95. Found: C, 25.8; H, 3.80.

The infrared spectra of 3-hydroxymethyl-3-iodomethyloxetane had the characteristic oxetane absorption peak at 970 cm.$^{-1,7}$ and hydroxyl peaks at 2850 and 3400 cm.$^{-1}$

2,2-Bisiodomethyl-1,3-propanediol. A mixture of sodium iodide (30 g.) and 2,4,8,10-tetraoxa-3,9-dithia[5,5]undecane-3,9-oxide[8] (22.8 g.) in dry methyl ethyl ketone (300 ml.) was refluxed for 36 hr. with constant stirring. Removal of the solvent gave a heavy oil which was extracted twice with methylene chloride (150 ml.). The solid which remained proved to be the starting material (2.7 g.).

The combined methylene chloride extracts were dried with calcium sulfate and upon removal of the solvent gave an oil (17 g.). Trituration with ethanol gave additional starting material (1 g.). Removal of the ethanol gave an oil which was crystallized from water and gave 2,2-bisiodomethyl-1,3-propanediol (11 g.) melting at 129–130°. The literature[9] reports a similar melting point.

Anal. Calcd. for $C_5H_{10}O_2I_2$: C, 16.86; H, 2.81. Found: C, 16.65; H, 3.02.

Reaction of sodium iodide with 5-methyl-5-hydroxymethyl-1,3,2-dioxathiane-2-oxide. A solution of sodium iodide (60 g.) and 5-methyl-5-hydroxymethyl-1,3,2-dioxathiane-2-oxide[3] (64 g.) in methyl isopropyl ketone (500 ml.) protected from light was refluxed with stirring for 48 hr. Removal of the solvent gave an oil which was separated by distillation into two fractions. The first fraction boiling at 110–140° (7 mm.) proved to be mainly starting materials (35 g.). The second fraction, which distilled at 160° (7 mm.), gave an oil which upon crystallization from chloroform gave 13.4 g. of a white solid melting at 70–71°. Analysis and a molecular weight determination in camphor indicated that this solid was a molecular complex of 2-methyl-2-hydroxymethyl-1,3-propanediol and 2-methyl-2-hydroxymethyl-3-iodo-1-propanol.

Anal. Calcd. for $C_{10}H_{22}O_5I$: C, 32.35; H, 6.76; I, 37.33. Found: C, 32.67; H, 6.58; I, 37.24. Mol. wt. 349.9. Found: 354.4, 350.8 (Rast) (Acetone, b.p. el.) 184, 145.

Five fractional crystallizations of the complex (3 g.) from acetone at −70° gave 0.05 g. of 2-methyl-2-hydroxymethyl-1,3-propanediol melting at 199–200°.

Reaction of 5,5-dimethyl-1,3,2-dioxathiane-2-oxide with sodium iodide. 5,5-Dimethyl-1,3,2-dioxathiane-2-oxide[10] (30 g.) and sodium iodide (30 g.) were refluxed in methyl isopropyl ketone (600 ml.) with stirring and protected against light for 48 hr. Removal of the solvent gave a dark residue which was fractionally distilled. Starting material (17.6 g.) was obtained together with 2.0 g. of a liquid which boiled at 106–110° (35 mm.). Two further distillations gave a sample which had an approximate analysis for 2,2-dimethyl-3-iodo-1-propanol.

Department of Chemistry
State University of Iowa
Iowa City, Iowa

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(4) Melting points and boiling points are not corrected.

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Preparation of 2,2,2-Trinitroethanol[1]

Henry Feuer and Thomas J. Kucera

Received April 4, 1960

The synthesis of trinitroethanol (I) has been reported from the reaction of trinitromethane with

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[1] From the Ph.D. Thesis of Thomas J. Kucera, Purdue University, August 1953.