A Method for the Specific Conversion of Iodoform to Carbon Dioxide

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Iodoform may be specifically converted to carbon dioxide *via* carbon monoxide. The latter is generated by reaction of silver nitrate with iodoform, and the carbon monoxide is specifically oxidized by a sulfuric acid–iodine pentoxide mixture. A method for carrying out the reactions in one procedure is described. The yield of carbon dioxide is 95% of theoretical based on iodoform.

Introduction

In the chemical degradation of carbon-isotope labeled compounds iodoform has often served as an intermediate. This compound has heretofore been converted to carbon dioxide by total oxidation, usually by the wet combustion procedure of Van Slyke and Folch.[1] The latter procedure permits the introduction of adventitious, non-isotopic carbon which is particularly apt to occur with iodoform because of its low content of carbon in relation to mass. This method of iodoform analysis has been shown to cause difficulty in the determination of the correct specific activity of carbon fractions of glycogen,[2] cholesterol[3] and aspartic acid,[4] particularly if the amounts of iodoform available for analysis are small (0.5 mM. or less). Sublimation of iodoform prior to oxidation minimizes the dilution, but may not avoid it if the sample amount is small.[5] Therefore, the following method has been developed as a reliable and relatively easy means of specific conversion of iodoform to carbon dioxide. Iodoform is first reacted with silver nitrate to form carbon monoxide,[6] which is then converted to carbon dioxide by a specific oxidant, a sulfuric acid–iodine pentoxide mixture.[7]

Method

The train of apparatus consists of a three-neck flask fitted with a reflux condenser, a dropping funnel, and an air inlet tube and connected in series to tubes containing Anhydrone, Ascarite, finely granular $ZnCl_2$, the H_2SO_4–I_2O_5 mixture and 2.5 N CO_2-free NaOH solution in that order. Zinc chloride removes any ethanol escaping the condenser. The iodic sulfate is prepared by the method of Schutze.[7] The tube containing this reagent should be packed with glass wool at both ends, and kept tightly stoppered when not in use. A small drying tube of iodic sulfate may be used many times before replacement of the reagent is necessary.

The iodoform sample is placed in the flask together with 50 ml. of 20% ethyl alcohol. A 200% excess of 0.1 N aqueous $AgNO_3$ solution (*i.e.*, a total of nine molar equivalents of $AgNO_3$) is placed in the dropping funnel. The $AgNO_3$ solution is acidified with 1–2 ml. of concentrated HNO_3 per 50 ml. The flask is heated on a water-bath to reflux temperature while aerating the system (minus the CO_2 receiver). The CO_2 absorption tube is then attached. The $AgNO_3$ solution is added dropwise to the flask, and the mixture heated under reflux for 30 to 45 minutes. After termination of reflux, aeration is maintained for 10 minutes in order to flush all the CO_2 into the absorber. The yield of carbon dioxide is 95–98% of the theoretical amount based on iodoform.

C-14-Iodoform sample	Method of combustion	Specific activity of CO_2 (counts/minute/mg. C)
1	CrO_3	10,900
	CrO_3	10,100
	$AgNO_3$	11,000
	$AgNO_3$	11,000
2	CrO_3	1,250
	$AgNO_3$	1,310

Results

A comparison has been made of the specific radioactivity of carbon dioxide obtained from C-14-iodoform by the use of either the chromic acid combustion mixture of Van Slyke and Folch[1] or a combination of silver nitrate and sulfuric acid–iodine pentoxide mixture. Methyl-labeled acetone was treated with iodine and sodium hydroxide to produce labeled iodoform. Aliquots (0.3 to 0.4 mM.) of the same iodoform sample were oxidized by one or another of the two methods. Reasonable precautions were taken to exclude extraneous carbon in the chromic acid combustion procedure. C-14-Sodium carbonate was converted to barium carbonate for solid sample counting with an end-window G–M tube. The standard deviation of the radioactivity count was at most 3%. It may be seen that two of the three iodoform samples oxidized with the chromic–sulfuric acid mixture yielded carbon dioxide with significantly lower specific activity than corresponding samples oxidized by the more specific method.

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