

A METHOD FOR THE QUANTITATIVE ESTIMATION OF CHLOROFORM IN CHLOROFORM LINIMENT.*

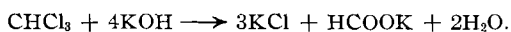
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Several methods are given in literature for the estimation of chloroform in Chloroform Liniment. The simplest method is to distil the chloroform into water (1). Sulphuric acid is then added to the distillate causing the chloroform to settle out, thus enabling one to read the quantity of chloroform directly. Several processes are also given in which the chloroform is decomposed by alcoholic potassium hydroxide into potassium chloride, potassium formate and water (2). The chloride is then determined either volumetrically or gravimetrically.

The appearance of this process in several stages of development in literature (2) and in textbooks (2) of Chemistry excited the curiosity of the investigator with subsequent experimentation. A process of this nature was developed which proved to be fairly satisfactory. The process does not differ greatly from that offered by another investigator (2) except in the apparatus used. According to literature, investigators have used pressure bottles and reflux condensers in order to decompose the chloroform. The author used a U condenser (diagram) which combined the idea of a pressure bottle and reflux condenser. This piece of apparatus was found to be the most satisfactory to drive the reaction to completion, and to give results with the minimum error. The reflux condenser is unsatisfactory because it permits small amounts of chloroform to volat-

ilize off. The pressure bottle was also found to be unsatisfactory because of the air space between the surface of the liquid and the stopper in which a great deal of chloroform may exist in the vapor state and escape decomposition.

The process developed is briefly as follows:



Five cubic centimeters of Chloroform Liniment are accurately measured into a hard glass test-tube of about eighty cubic centimeters capacity, containing 50 cc. of alcoholic potassium hydroxide (12 Gm. of KOH U. S. P. dissolved in 10 cc. of boiling distilled water with subsequent addition of ethyl alcohol to make the volume 100 cc.). A U condenser (diagram) is at once inserted into the test-tube. The condenser should be long enough to extend a half inch below the surface of the liquid in the test-tube. Connect the condenser with the cold water supply,

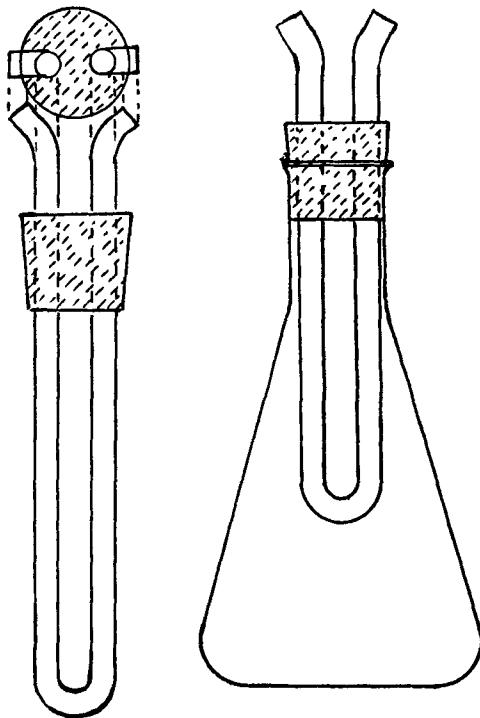


Fig. 1.

* Section on Practical Pharmacy and Dispensing, A. Ph. A., Rapid City meeting, 1929.

wire the stopper securely into the tube, immerse the test-tube in a water-bath and heat at the temperature of boiling water for one-half hour.

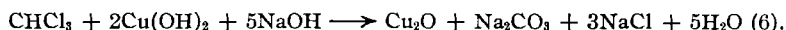
After the reaction has ceased, cool the contents of the tube and pour into a 600-cc. beaker. Rinse the condenser and tube with hot distilled water and add the washings to the liquid in the beaker. Then add 100 cc. of distilled water to the beaker and heat at a temperature below 100° C. for one-half hour in order to remove the alcohol. Then add another 100 cc. of distilled water and boil for 15 minutes to decompose the potassium formate and free the liquid of all volatile material. Cool and add concentrated nitric acid in excess. The chlorides may be determined volumetrically by Volhard's method (4) or gravimetrically by precipitation with silver nitrate.

It was found advisable to work on aliquot portions of the liquid containing the chloride. This process was repeatedly tried, using a pressure bottle and reflux condenser, but with very poor results.

The work with this process convinced the investigator that it was too slow and required too much technique for ordinary use, so a simpler process was sought for and developed.

It was found that chloroform reduces Fehling's solution to cuprous oxide when warmed (5). Soap liniment alone, even when heated to boiling, would not cause reduction.

The reaction upon which the process is based is



Molecular weights used:

Chloroform 119.39

Cupric hydroxide 97.586

Cuprous oxide 143.14

Cupric sulphate, hydrated 249.71

1.19892 Gm. of cuprous oxide are formed for each Gm. of chloroform.

1.63474 Gm. of cupric hydroxide are required for each Gm. of chloroform.

13.549 Gm. of cupric hydroxide in one liter of Fehling's solutions.

Reagents.

Fehling's Solution.—A—Dissolve 34.66 Gm. of carefully selected crystals of copper sulphate in enough distilled water to make a volume of 500 cc.

B—Dissolve 173 Gm. of Rochelle salt and 50 Gm. of sodium hydroxide in enough distilled water to make a volume of 500 cc.

Hydrochloric acid 10 per cent

Sodium hydroxide 10 per cent

Nitric acid 10 per cent

Alcohol U. S. P.

Ether U. S. P.

Shredded asbestos.

Apparatus.

U Condenser.—A piece of glass tubing with an outside diameter of about 7 mm. and about 30 cm. long is heated in the flame and bent double, the radius of the bend being about one cm. The ends are then fire polished and forced through a two-hole number 5 rubber stopper. The distance from the top of the stopper to the end of the bend should be about 11 cm. The open ends may then be reheated and bent away from each other.

This stopper containing the condenser is to be forced into the neck of a 250-cc. Erlenmeyer flask and wired down. The object being to obtain a combination pressure bottle and reflux condenser. The condenser must be the specified

length, a 250-cc. Erlenmeyer flask must be used, and the quantities later specified must be added in order that the condenser may extend below the surface of the liquid in the flask. The condenser is to be connected with the cold water supply and water shall be kept flowing through the tube during the entire reaction.

Gooch Crucible.—Digest shredded asbestos of good quality with 10% hydrochloric acid for three days, wash free from acid and digest for a similar period with a 10% solution of sodium hydroxide. Then treat for a few hours with hot Fehling's solution of the same strength as used in the assay. Wash free from alkali and finally digest with 10% nitric acid for several hours. After washing free from acid, shake with water for use. To prepare the Gooch crucible, load it with a film of asbestos about one-quarter of an inch thick, using suction. Wash thoroughly to remove the finer particles of asbestos, and finally wash with alcohol and ether. Dry for thirty minutes at 100° C., cool and weigh.

Procedure.—Measure accurately 15 cc. of Chloroform Liniment into a 100-cc. volumetric flask containing alcohol. Add enough alcohol to make up to the mark and mix well.

Place 50 cc. each of Fehling's solutions A and B into a 250-cc. Erlenmeyer flask. Add 90 cc. of distilled water and 7.5 cc. of the above alcoholic dilution of Chloroform Liniment. Immediately insert the stopper containing the U condenser and wire it down securely. A tight fit may best be secured by wetting the stopper with water before forcing it into the neck of the flask. Care should be taken that the condenser extends below the surface of the liquid. Connect the condenser with the water supply and start the cold water flowing through it. Then place the Erlenmeyer in the water-bath at such a depth that the surface of the water in the bath is slightly higher than the surface of the liquid in the flask.

Heat the water in the bath to 87° C. (not less than 80° nor more than 90° C.), and keep the bath at this temperature for ten minutes. Then remove the Erlenmeyer and cool under running water to room temperature without stopping the flow of water through the condenser. When cool, rotate the flask gently in order to wash the condensed liquids adhering to the side down into the main portion. Replace the flask in the bath and heat to the same temperature for another ten minutes. Cool as before, and repeat the entire process a third time.

When cool after the third heating, remove the U condenser and wash with distilled water into the main portion. Without further dilution, filter the cuprous oxide on an asbestos felt in a porcelain crucible using suction. Wash the flask and the precipitate thoroughly with water at a temperature of 60° C. Then wash the cuprous oxide with 10 cc. of alcohol followed by 10 cc. of ether. Dry the crucible and contents at 100° C. for thirty minutes. Cool and weigh as cuprous oxide.

Each Gm. of cuprous oxide corresponds to 0.83408 Gm. of chloroform, and to 0.5651 cubic centimeter of chloroform when the specific gravity of the chloroform is 1.476 at 25° C. (The average of the specific gravity of the U. S. P.)

Example of calculation of results.

Sample.—Fifteen cc. of chloroform liniment diluted to 100 cc. with alcohol. Each cc. is equivalent to 0.15 cc. of liniment.

Aliquot portion used—7.5 cc. of the above dilution.

7.5 × 0.15 equals 1.125 cc. of chloroform liniment used in the assay.	
Gooch and cuprous oxide	17.681 Gm.
Gooch	17.097 Gm.

Cuprous oxide	0.584 Gm.

Factor.—Each Gm. of cuprous oxide is equivalent to 0.5651 cubic centimeter of chloroform or to 0.83408 Gm. of chloroform.

$$\frac{0.584 \times 0.5651 \times 100}{1.125} \text{ equals } 29.33\% \text{ of chloroform by volume.}$$

$$\frac{0.584 \times 0.83408 \times 100}{1.125} \text{ equals } 43.298\% \text{ of chloroform weight to volume.}$$

CONCLUSION.

The greatest source of error in the estimation of the chloroform in Chloroform Liniment is in measuring the sample and in measuring the aliquot portion of the alcoholic dilution to be used, because of the extreme volatility of the chloroform. Due to this extreme volatility it is very easy to lose a small portion of the chloroform through spontaneous evaporation and when small samples are used, as they are in this method, even a slight loss causes considerable error.

The following precautions might be mentioned:

1. When adding the Chloroform Liniment to the alcohol, exacting care must be taken that none of the liniment touches the side of the flask, but instead flows directly into the alcohol.

2. In measuring the liniment and the alcoholic dilution of the liniment, pipettes may be used, but in each case, about five cc. more of the material should be drawn up into the pipette than is needed for the assay.

No unreasonable results are claimed for this process, but it is believed that with care in the manipulation, the method will prove accurate enough for all practical purposes. Since it is impossible to determine the specific gravity of the chloroform from which samples of liniment obtained at random are made, some figure for the gravity must be assumed in order to be able to report the per cent of chloroform by volume in the liniment. Therefore, it is assumed that the chloroform from which all liniment is made has a gravity of 1.476 at 25° C. This figure is the mean of the range of gravity allowed by the U. S. P. X for chloroform (7).

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