MICRO-DETERMINATION OF ETHYL ALCOHOL

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Ethyl alcohol has been colorimetrically estimated in as low a concentration as 1 μg.

The method frequently used for the estimation of ethyl alcohol in body fluids and tissues involves the oxidation of ethyl alcohol by potassium dichromate-sulphuric acid mixture and subsequent colorimetric determination of residual dichromate[1]. However, the method is not sensitive for the estimation of alcohol below 100 μg. A modified method, in which the residual dichromate was coupled with S-diphenyl carbazide, was developed by Williams and Reese[2]. And although quantities as low as 5 μg could be estimated by this method, it required precise control of acidity and a large dilution of chromic ions. In addition, the chromogenic reagent is not quite stable. Nickolls[3] added potassium iodide to the residual dichromate and titrated the liberated iodine against thiosulphate. Bourcherle and co-workers[4] estimated the residual dichromate iodometrically employing a macrodiffusion technique. The present communication reports the estimation of residual dichromate by employing cadmium iodide-starch reagent. The method is rapid and quite sensitive for the determination of alcohol upto 2 μg.

EXPERIMENTAL PROCEDURE

The oxidation of alcohol was carried out in a ground glass tube (Fig. 1) provided with a glass cup (1 ml capacity) attached to the stopper. When the stopper is in position the cup remains 2 cm above the bottom of the tube. The sample containing alcohol was placed in the cup and dichromate solution in the required quantity (Table 1) was taken in the tube.

Table 1

QUANTITIES OF REAGENTS USED IN ESTIMATING ALCOHOL

Concentration of alcohol	Concentration of $K_2Cr_2O_7$ in sulphuric acid (50% V/V)	Volume of acid-dichromate for alcohol oxidation	Volume after oxidation	Volume taken for colorimetric analysis	Volume of 3·6 N Sulphuric acid added
μg	μg/ml	ml	ml	ml	ml
1—10	250	0·2	Nil	All	Nil
10—100	500	1·0	10·0	2·0	Nil
100—350	1,750	1·0	10·0	0·8	0·6

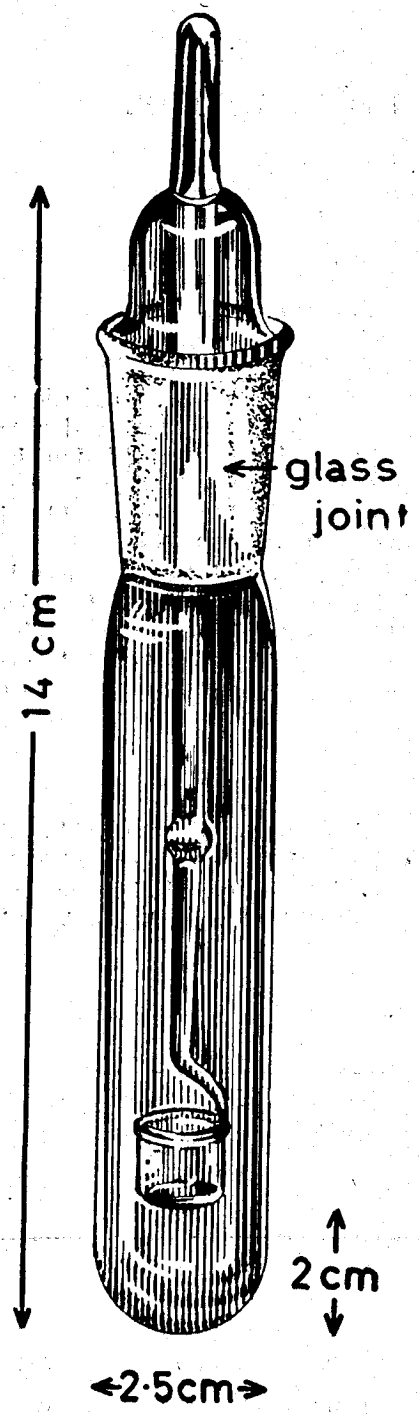

FIG. 1—Tube for alcohol oxidation.

The tube was incubated at 45°C for two hours[5]. Under this condition, acetone was not oxidised. The tube was removed from the incubator and the dichromate solution suitably diluted. A known volume was taken and 5 ml of cadmium iodide-starch reagent[6] (containing 0·20 g cadmium iodide and 1·56 g soluble starch per litre) was added and the volume made upto 10 ml. In certain cases, 3·6 N sulphuric acid was added to bring the acid concentration to 0·36 N in the final solution. A reagent blank was prepared by mixing 1 ml of 3·6 N sulphuric acid and 5 ml of cadmium iodide-starch reagent and making up the volume to 10 ml. Against this reagent blank, the blue colour of starchiodine complex was estimated after 20 min. in a Spekker absorptiometer at 610 mμ. Glass cuvettes of 0·5 cm path length were used.

Fig. 2 shows the relationship between optical density (blue colours) and alcohol concentration ranges 1-10 μg and 10-100 μg.

The results of estimation of alcohol (100-350 μg) by the new method were compared with those obtained by the direct estimation of residual dichromate. For the estimation of optical densities by the later method, a 1·5 cm cell was employed instead of the 0·5 cm cell. Fig. 3 gives the results.

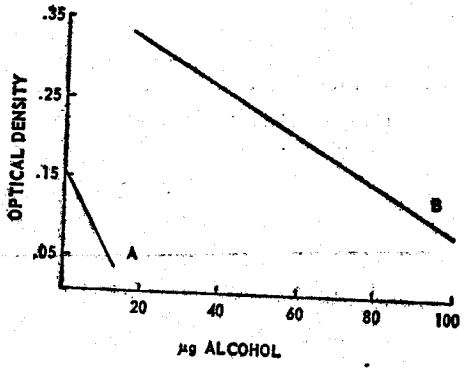

FIG. 2—Estimation of alcohol using cadmium Iodide-starch reagent. (A=0 to 10 μg alcohol, B=0 to 100 μg alcohol).

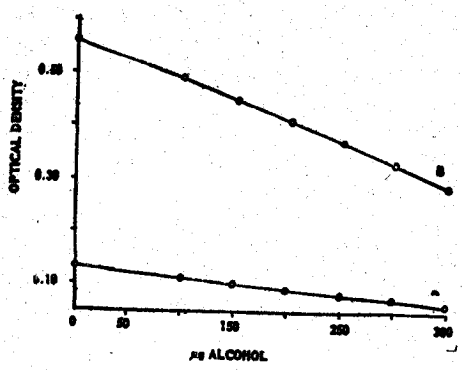

Fig. 3—Comparison of direct estimation of dichromate with cadmium Iodide-starch reagent after alcohol oxidation.

Since the optical densities determined in 1·5 cm cell were approximately 3 times higher as compared to those in 0·5 cm cell, the estimation of residual dichromate with cadmium iodide-starch reagent is 15 times sensitive as compared to direct colorimetric estimation of dichromate. Moreover, a precise control of acidity and a large dilution is not necessary and the chromogenic reagent is stable at room temperature. Above 350 μg of alcohol, direct colorimetric estimation of residual dichromate at 450 or 375 $m\mu$ is possible and addition of cadmium iodide-starch reagent is unnecessary.

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