K14 Quantitative Determination of Ethylene Glycol Using Capillary Gas Chromatography by Direct Specimen Injection

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The goal of this presentation is to demonstrate how this method is useful in forensic and clinical cases to determine ethylene glycol concentrations by gas chromatography.

This presentation will impact the forensic science community with a more efficient and accurate method for quantification of ethylene glycol in blood or serum.

Ethylene glycol (EG) can be accidently ingested or sometimes abused by alcoholics for intoxication when no other form of alcohol is available; in either situation, untreated poisonings from overdose can be fatal. The consequences of consuming EG range from central nervous system depression to anionic acidosis and eventually death. Pathologists commonly discover calcium oxalate crystals while reviewing EG poisonings deposited in the brain, lungs, kidneys, and heart. EG blood concentration > 20 mg/dL should receive medical treatment; > 50 mg/dL are usually associated with severe intoxication; and > 200 mg/dL have been lethal. An approximate lethal oral dose of 95% EG is 1.5 mL/kg. The goal of the present work is to develop an effective method to analytically measure EG concentrations in biological fluids. Gas chromatographic methodology was performed on a gas chromatograph (GC) equipped with an auto sampler using a 5 µL syringe for a 1 µL injection; 4mm internal diameter splitter liner (@ 235°C); a 30 meter, 0.32 mm internal diameter, 1.80 µm film thickness novel stationary phase column and a 10 meter guard column (using a time temperature program of 100-140°C at 7.0°C/min, then 140-170°C at 40 °C/min); a flame ionization detector (@ 240°C); and helium as a carrier gas (@ 1.5 mL/min). EG and 1,2 propylene glycol (internal standard) separate at retention times of 3.58 and 3.77 minutes, respectively. Time temperature programming maximizes oven temperature to ensure all biological material is eliminated following injection. Computer software was used to analyze chromatograms for peak identification and quantitation. Acetone, methanol, ethanol, and isopropanol do not interfere with the chromatography of the glycols. The method is linear over a range of 20 to 200 mg/dL. Samples above the linear range are diluted appropriately with deionized water to fit within the standard curve.

Between-day and within-day replication of three controls (37.5, 75, and 150 mg/dL) were analyzed to test the reproducibility and accuracy of the method. Results of within-day replication (n=6) of the controls were (mean concentration ± SE, coefficient of variation): 37.8 ± 0.166; 1.08%; 77.2 ± 0.307, 0.976%; and 157.2 ± 1.19, 1.86%. Likewise, results of between-day replication of controls (n=6) revealed (mean concentration ±SE, coefficient of variation): 37.6 ± 0.211, 1.37%; 76.5±0.428, 1.37%; and 153 ± 2.29, 3.67%. Determination of the limit of detection was determined by serial dilution to be 1 mg/dL. The limit of quantitation for the method yielded a significant concentration of 5 mg/dL. The usefulness of this method was confirmed by application to clinical specimens. Case in point, a 39-year-old male was admitted to the hospital after consuming EG. EG blood concentrations were determined using this method ranging from 382 to 67 mg/dL. EG was removed from the patient's circulation by hemodialysis to an undetectable concentration over a four day period and physicians were able to stop treatment. GC of biological fluids by direct injection onto a capillary column has proven to be an effective, sensitive, and accurate method for determining EG blood concentrations. Distinct advantages of direct injection, capillary GC over other methodologies is that it is rapid, does not require any special specimen preparation and only requires a minimum of 10 µL of specimen. This method is useful in forensic and clinical cases to determine EG concentrations.

Ethylene Glycol, Gas Chromatography, Capillary

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