Urinary (2-Methoxyethoxy) Acetic Acid: An Effective Gas Chromatographic Test Method for Quantification

C. B Hymer, K. L. Cheever and M. A. Butler, National Institute for Occupational Safety and Health, Centers for Disease Control and Prevention, Cincinnati, OH

(2-Methoxyethoxy)acetic acid (MEAA) is a metabolite and biomarker for exposure to 2-(2-methoxyethoxy)ethanol (diethylene glycol monomethyl ether, DEGME, or DiEGME) and bis(2-methoxyethyl) ether (diglyme); both are glycol ethers and are of concern because of the general toxicity of these compounds. Glycol ethers have been frequently reported to damage the male reproductive system, hemaopietic system, and fetal/embryonic development. Occupational exposure by these widely used glycol ethers are likely, since they are readily absorbed through the skin. Specifically, 2-(2-methoxyethoxy)ethanol is used as an anti-icing additive to the military jet fuel JP-8, and bis(2-methoxyethyl) ether is an aprotonic solvent with industrial uses and is a component of some hydraulic fluids including brake fluid. A simple and effective general test method for MEAA in urine samples was developed to monitor any exposed population. Urine specimens were first spiked with deuterated (2-butoxy)acetic acid, which was used as a procedural internal standard. The samples were extracted with ethyl acetate, concentrated, and treated by acid catalyzed esterification to produce the corresponding ethyl esters of MEAA and the internal standard. Subsequently, the ethyl ester derivatives were extracted using methylene chloride and concentrated to produce the final solution for gas chromatographic analysis. A mass selective detector (MSD) using a 50-m X 0.20-mm (id) HP-1 capillary column and a temperature program of 50 to 230°C was used for the gas chromatographic measurement. Ion m/z 59 was monitored for the ethyl ester of MEAA and ion m/z 66 was monitored for the internal standard. A recovery study using 2, 10 and 20 _g/ml MEAA spiked urine samples demonstrated good accuracy and precision; recovery varied between 95-103%. The limit of detection (LOD) was found to be approximately 0.1 _g/ml (0.8 _mol/L) for this analysis method.

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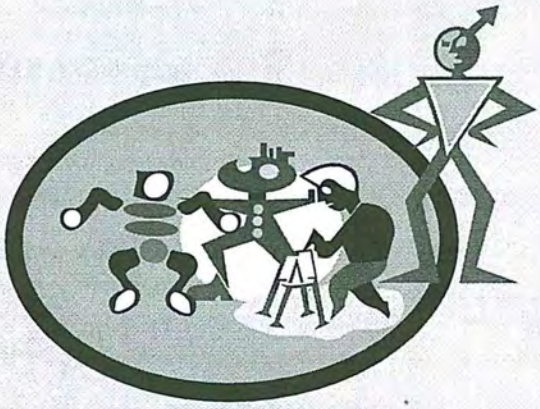

Abstract

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