K32 Improved Blood Alcohol Concentration Analysis Utilizing Two Novel Chromatographic Stationary Phases

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Headspace gas chromatographic analysis of blood alcohol concentration is a routine analysis carried out in forensic laboratories. After attending this presentation, attendees will understand the principles of blood alcohol headspace analysis and why the forensic community is focused on optimizing this methodology.

This presentation will impact the forensic science community by providing an improved methodology for the analysis of blood alcohol concentration. The improvement focuses on the modification of the protocol, the automation of the analysis, and the separation and resolution of the alcohols.

In the United States, alcohol abuse is associated with automobile fatalities, industrial accidents, and numerous other incidents such as alcohol poisoning and drug facilitated sexual assault. Due to its enormous impact on society, a rapid and precise methodology for the determination of blood alcohol concentration is desired.

Blood alcohol concentration reflects the amount of ethyl alcohol in the body. The most significant blood alcohol compound is ethanol. After ethanol is absorbed through the stomach and small intestine, it is eliminated from the body via metabolism and excretion. To accurately determine a subject's blood alcohol concentration, numerous factors must be taken into account, including the qualitative and quantitative analysis of the alcohols and their metabolites. There are a number of other compounds present such as methanol, isopropanol, and acetone that can interfere with the identification and quantitation of ethanol. A common interference observed with these other alcohols is their possible co-elution with ethanol. By use of the application specific columns, an improved baseline resolution of ethanol from all other potential components can be achieved.

The presentation will focus on the improvement of the established methods for blood alcohol analysis. Current methods include both direct gas headspace and solid-phase microextraction (SPME) under either static or dynamic conditions. The direct injection methodology does not have optimal standards due to its sample introduction of biological samples onto the gas chromatographic column. This frequently leads to column contamination and decreases performance. The integration of head space sampling into the method prevents the buildup of non-volatile contaminates in the injector and on the column. It also helps to maintain consistent performance and extends the lifetime of the column.

The selected instrumental technique is gas chromatography combined with either a mass spectrometer (GC–MS) or a flame ionization detector (GC–FID). The main element of this improved methodology is the use of two new gas chromatographic column stationary phases. These stationary phases, which are application specific, show an improvement in the separation and resolution of the studied alcohols.

These two capillary column stationary phases were developed specifically for blood alcohol analysis. The new stationary phases focus on the same analysis, but will improve the baseline resolution of all low molecular weight alcohols and their metabolites in minimum needed analysis time.

The presented method includes the evaluation of blood alcohol concentration by both direct gas headspace and SPME. An investigation of the method detection limits (MDLs) was also conducted in order to report with greater confidence the degree of uncertainty than previous methods (0.025 – 0.100 %). The instrumental technique utilized was GC–FID. The technique was chosen because of its accessibility in forensic labs, low operating costs, reliability, as well as its specificity in analyzing these volatile compounds.

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