Detection of Ethanol in Exhaled Breath Condensate: A Preliminary Study

Michele L. Merves¹, Chris W. Chronister¹, W. Brit Smith², Timothy E. Morey², Richard J. Melker², Donn M. Dennis², and Bruce A. Goldberger¹

¹Department of Pathology, Immunology and Laboratory Medicine, University of Florida, P.O. Box 100275, Gainesville, FL 32610, USA
²Department of Anesthesiology, University of Florida, P.O. Box 100254, Gainesville, FL 32610, USA

Ethanol is a central nervous system depressant and widely consumed drug. Although it has been extensively studied in gaseous exhaled breath (referred to as breath), little is known regarding the disposition of ethanol in exhaled breath condensate (EBC). EBC is collected by condensing exhaled breath vapor onto the walls of a chilled collection device, such as the commercially-available Jaeger ECoScreen. This project studies the measurement of ethanol in breath from a unique perspective, one that requires multiple breaths for a single EBC specimen. The results would highlight the importance of breathing patterns in understanding the relationship between blood and breath ethanol concentrations.

In this preliminary study, 4 human participants (3 males, 1 female) were enrolled on separate days. Prior to the consumption of an ethanol-containing beverage, all subjects provided a baseline set of specimens, which included breath, EBC, blood and oral fluid. Breath ethanol concentrations were determined in real-time by the Intoximeters AlcoSensor IV device. All other specimens were collected and stored for ethanol analysis by an automated headspace gas chromatography with flame ionization detection technique. The EBC was collected with a user-modified ECoScreen device that isolated deep lung gas and condensed it at a temperature near -10°C. Venous blood was collected using a phlebotomy technique with an IV catheter placed into the left arm or hand of each individual, and oral fluid was collected using Sarstedt Salivettes.

The ethanol dose administered to each subject was calculated based on the subject’s weight, and the subject was not to exceed a blood ethanol concentration of 0.10 g/dL. The beverage was consumed within 40 minutes, and the subjects had minimal food in their stomachs. Breath ethanol concentrations were monitored for the remainder of the study using the AlcoSensor IV device. During the post-absorptive phase, multiple sets of specimens were taken in a similar manner as the baseline specimen set.

Ethanol was detected in EBC of subjects after consuming the ethanol-containing beverage. The inter-individual EBC-to-blood ethanol ratio ranged from 1.5 - 3.9. This ratio is highly dependent on the subject’s breathing patterns including respiratory rate and volume, and its variability can be minimized by employing standardized breathing patterns.

Although there is inter-individual variability, results of this preliminary suggest a potential intra-individual correlation between alcohol concentrations in EBC and venous blood when normal breathing patterns are sustained. Correlations between concentrations in blood, oral fluid and breath during the post-absorptive state are consistent with published values.

Keywords: Ethanol, Breath, Exhaled breath condensate