

Alcohol Information

Classification

Common alcohols are a group of compounds whose structures include a hydroxyl group attached to a carbon chain of varying length. The number of carbons determine both the name and individual properties. The common alcohols are designated as primary, secondary, or tertiary depending on the number of carbons that are attached to the carbon bearing the hydroxyl group. Examples of primary alcohols include methanol and ethanol, which contain one and two carbons respectively. Secondary alcohols include isopropanol, a three carbon alcohol. Tertiary or four carbon alcohols include N-butanol. The information contained herein will deal primarily with ethanol, or beverage alcohol.

Metabolism

Ethanol is a small molecule which is readily soluble in water and penetrates membranes throughout the GI tract, including the mouth, stomach and small intestine. Rate of absorption varies greatly due to factors such as type of beverage ingested, quantity of food in the stomach, frequency of gastric emptying, drinking pattern, etc. The average time to peak absorption is usually 30 to 60 minutes, but may range from 15 minutes to 3 hours. Approximately 95% of an ingested dose of ethanol is metabolized by liver enzymes, principally alcohol dehydrogenase, with the remainder eliminated unchanged in the urine, breath, sweat, and feces. Ethanol is metabolized to acetaldehyde and then to a final end product of acetic acid. Distribution of alcohol throughout the body occurs via the blood supply and since ethanol is hydrophilic (strong affinity for water), it will diffuse into body tissue or fluid compartments such as urine, saliva, plasma, etc. Since plasma or serum have a higher percentage of water by unit volume, it will have a higher ethanol concentration than whole blood. A wide range of elimination rates exists, however, ethanol is typically metabolized at approximately .015-.018 gm/dL per hour in healthy individuals. Therefore, the detection time of ethanol in body fluids is dose dependent.

Abuse

Ethanol is the most widely consumed drug in society and is generally consumed socially. Ethanol is predominantly consumed as fermented or distilled beverages and is also a component of mouthwashes, medicinal, and industrial products. Fermented beverages such as beers and ales contain 3-6% ethanol by volume, wines contain 10-12%, and distilled spirits contain 20-60% ethanol. Acute ingestion of ethanol typically leads to progressive stages of effects depending upon the amount consumed. With low to moderate consumption, a person may initially experience mild euphoria, sociability, decreased inhibitions and the beginning of sensory-motor impairment. With increased consumption the

effects can progress to emotional instability, loss of perception, memory and comprehension in addition to decreased response time and slurred speech, staggered gait and loss of muscular coordination. Finally, excessive acute ethanol consumption can lead to impaired consciousness, respiratory depression, coma and death. Chronic ethanol abuse can result in multi-organ pathological effects. These can include cirrhosis of the liver, acute and chronic gastritis, pancreatitis, cardiomyopathy and various neurological and metabolic disorders.

Methods of Analysis

One of the most widely used techniques for detecting alcohols in urine include enzyme assay utilizing alcohol dehydrogenase. The method is very sensitive and specific in that methanol and acetone are not detected. However, longer chain alcohols such as isopropanol may be detected. This is appropriate for clinical settings, however, for forensic purposes, a secondary more definitive confirmation method is required. Gas chromatographic methods, either direct injection or headspace sampling, with the incorporation of an internal standard offer very accurate and precise quantitation of ethyl alcohol, in addition to identifying other volatile compounds such as methanol, acetone, isopropanol. Definitive identification of ethanol and accurate quantitation are required when relating a blood alcohol concentration to a particular level of impairment. This is especially critical when the blood alcohol concentration is to be used as evidence to determine whether grounds exist for presumption of impairment.