

A BI Incorporated Primer

Alcohol: How the body processes it and how we detect consumption

Because alcohol is a factor in a majority of the crimes committed in this country, monitoring alcohol use is a critical practice in the criminal justice system. This paper looks at how the body processes alcohol and how consumption can be detected.

Processing Alcohol in the Body

Absorption: Alcohol is not digested like other foods. Instead of being converted and transported to cells and tissues, it avoids the normal digestive process and goes directly to the blood stream. About 20% of alcohol is absorbed directly into the bloodstream from the stomach walls and 80% is absorbed into the bloodstream through the small intestine.

Distribution: Until all alcohol has been metabolized, it is distributed throughout the body. Alcohol is highly soluble in water and tends to distribute itself in the water tissues of the body. As a result, organs containing a lot of water, like the brain, are particularly vulnerable to alcohol penetration. In the brain, alcohol affects decision making and poor judgment.

Metabolism/Elimination: The body processes and eliminates alcohol through metabolism. About 90% of alcohol is metabolized through the liver. The other 10% is excreted from the body unchanged through breath, urine and sweat. In general, blood alcohol levels peak within 30 to 45 minutes after consumption of a drink.

The effects of alcohol vary from person to person. Different people consuming the same amount of alcohol may react differently and the same person can have different reactions on different occasions. There are several factors that affect metabolism and the effects of alcohol, including:

- **Drink strength** - In general, higher concentrations of alcohol result in more rapid absorption.
- **Drinking speed** - The more rapidly the beverage is ingested, the higher the peak blood alcohol concentration (BAC). The liver can only metabolize about 10 grams of alcohol per hour.
- **Food** - The longer the alcohol remains in the stomach, the longer it takes to reach the small intestine, slowing the rate of absorption into the bloodstream and thereby allowing the liver more time to metabolize alcohol. This explains why eating while drinking results in lower BAC levels.
- **Body weight** - The more mass and fluid in the body, the more diluted the alcohol in the body will be.
- **Gender** - Muscle tissue contains more water than fat tissue. On average, men have more muscle and less fat than women. As alcohol dilutes itself in water, females will reach a higher BAC than their male counterparts of the same weight when both drink the same amount of alcohol.
- **Drinking history** - As a person's drinking increases, his or her liver will increase its capacity to metabolize alcohol—a heavy drinker will be able to burn off drinks faster.
- **Taking drugs** - The effects of alcohol may be enhanced if the person is taking certain drugs, especially those of the sedative class such as sleeping pills.
- **Emotional and medical conditions** - The presence of a wide variety of medical conditions may affect one's alcohol tolerance. For example, many people seem more susceptible to the effects of alcohol when they are fatigued, have recently been ill, or are under emotional stress and strain. The usual amount of alcohol may result in uncomfortable effects.

Detecting Alcohol in the Body

Blood Alcohol Level is expressed in terms of concentration—the amount of alcohol in a certain amount of blood. This is expressed as blood alcohol concentration (BAC). Alcohol is a simple compound for which several accurate methods of measurement are known, is distributed in water throughout the body, and excreted unchanged in breath, urine and sweat.

When alcohol is consumed, it is absorbed into the blood stream. The majority of alcohol in the blood is metabolized by the liver, which can process up to 10 grams of alcohol per hour. When a person drinks more alcohol than his or her body can metabolize at one time, alcohol accumulates in the blood stream and BAC rises. The concentration is determined by a widely accepted “weight by volume” method, meaning the weight of alcohol (mgs) divided by the blood volume (dls). Blood from a peripheral vein can be used to draw and estimate the blood alcohol concentration, but in the criminal justice system, this is rarely practical.

As a result, alternative methods for determining alcohol consumption have been developed and are in use in law enforcement and corrections today:

- Breath alcohol testing
- Urinalysis testing
- Transdermal alcohol monitoring

Breath Alcohol Testing

As already stated, when alcohol is consumed it is absorbed into the blood stream. In the alveoli of the lungs, alcohol enters the air from the thin tissue layer between the alveoli and the blood stream. The exchange of alcohol to the breath occurs in this deep lung region. At this microscopic level, the concentration of alcohol in the air is directly dependent on the concentration in the adjacent blood stream and the temperature (Henry’s Law). As a result, through a calculated conversion alcohol concentration in the body can be measured by its concentration in breath, also known as breath alcohol concentration (BrAC).

Breath alcohol testing has been used as a reliable estimate of blood alcohol levels since the 1970s. Today, there are many commercial devices for measuring BrAC, including systems that use fuel cells, semiconductor sensors, infrared sensors, gas chromatography, and colorimetric measurement technologies.

Urinalysis Testing

Since urine is derived from the plasma in blood and stored in the kidneys, it can also detect alcohol consumption. The urine alcohol concentration (UAC) is at times highly correlated to BAC during the absorption process. However, since urine is stored in the bladder, testing is subject to variables such as the amount of time spent drinking and how often a person urinates. For this reason, the UAC is not a reliable measure of BAC, although it is used to detect the consumption of alcohol.

For over a century, scientists have known that 1-2% of alcohol is excreted through urine. Urinalysis testing, also called simply a UA, is a physical, chemical, and microscopic examination of urine. It involves a number of tests to detect and measure various compounds that pass through the urine. While there are many commercial testing systems, a standard urine test strip may comprise up to 10 different chemical pads that change color when immersed in, and then removed from, a sample.

Transdermal Alcohol Monitoring

Because alcohol is absorbed into the soft tissues, approximately 1% of all ingested alcohol is excreted through the skin in the form of sweat or vapor. The transdermal alcohol concentration (TAC) is highly correlated to BAC. Alcohol travels from mouth to stomach to blood stream to soft tissues before being excreted as sweat or vapor. As a result, TAC readings occur anywhere from half an hour to two hours after alcohol consumption due to the time it takes to process in the body and be expelled by the skin.

Using transdermal alcohol to detect alcohol consumption dates back to the 1930s and has been validated in science and the courts. Several methods have been used to measure TAC. Today, in criminal justice, both BI Incorporated (BI TAD™) and Alcohol Monitoring Systems (SCRAM) offer devices that measure TAC.

Sources:

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