14.2: Alcohol Absorption and Metabolism

Skills to Develop

• Explain the digestion and metabolism of alcohol

In this section, we will discuss how alcohol is absorbed and metabolized.

Absorption

Alcohol is passively absorbed primarily in the small intestine although small amounts may be absorbed in the mouth, stomach and large intestine. The rate of absorption depends on body size; the larger the person, the slower absorption. So a person who weighs 180 lbs will take longer to absorb one beer than someone who weighs 120 lbs. For example, someone who weighs 180 lbs will absorb 9-16 grams of alcohol per hour while someone weighing 120 lbs will absorb 6-10 grams of alcohol per hour. Other factors also affect alcohol absorption. Eating food, particularly fat, protein and fiber, while drinking alcohol will slow absorption while carbonated alcoholic beverages are absorbed faster. Women are more proficient at absorbing alcohol than men. Once absorbed, alcohol reaches the brain quickly where it alters mental and physical functions.

Metabolism

More than 90 percent of ingested alcohol is metabolized in the liver at a rate of approximately half an ounce per hour, but the rate varies from person to person. The rate of degradation and clearance in the liver depends on a variety of genetic and environmental factors including body size, previous alcohol exposure, food intake and one's general health. While waiting to be degraded, alcohol stays in the blood and some will be excreted through the breath (which is how Breathalyzers work), urine, saliva, and sweat.
There are three systems in the liver for degrading or detoxifying alcohol (Fig. (1)). These are the alcohol dehydrogenase (ADH) system, the microsomal ethanol-oxidizing system (MEOS), and the acetaldehyde dehydrogenase (ALDH) system. ADH and ALDH work together to break alcohol down to acetate which is easier to remove from the body. ADH degrades ethanol to acetaldehyde, a known carcinogen. Some ADH exists in the stomach and levels of this enzyme are diminished by fasting. ALDH quickly degrades the acetaldehyde to acetate which is further broken down to carbon dioxide and water in extrahepatic tissues. People of Asian descent have reduced levels of ALDH and this contributes to the flushing commonly experienced after drinking alcohol. Other side effects of acetaldehyde build up is rapid heartbeat and hyper ventilation. One fifth of the alcohol absorbed is degraded by MEOS to acetaldehyde.

The chemical pathways involved in degrading ethanol use NAD\(^+\) and take it from other pathways such as glycolysis (the breakdown of glucose) and the TCA (tricarboxylic acid) cycle (also known as the Krebs cycle) which generates energy from glucose. As a result, NADH\(_2\) accumulates and slows the TCA cycle causing acetyl CoA to accumulate. Excess acetyl CoA is diverted to fatty acid synthesis and the fatty acids are incorporated into triglycerides. These triglycerides can accumulate in the liver and over time clog the liver and impair function. This is one of the proposed mechanisms by which fatty accumulates in the liver following alcohol intake.

When alcohol is consumed in excess, ethanol circulates in the blood until liver enzymes are available to degrade it. The byproduct of degradation, acetaldehyde, is harmful. Also, alcohol decreases the production of antidiuretic hormone (ADH) and decreased levels of ADH prevents the retention of water so water and water soluble vitamin losses are increased. Alcoholic beverages do not hydrate and excess intake can lead to dehydration.

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**Figure (1):** Break down of alcohol into acetaldehyde and acetate.