

Acid/Base Balance

One of the most important homeostatic variables of the body is pH. Normal arterial pH is 7.4 (7.35-7.45). Be aware that the pH of other body fluids may be quite different from that of arterial blood. For example, the pH in the stomach may be as low as 1, pancreatic fluid is about 8.1, venous blood is close to 7.35 and urine ranges from 4.5 to 8. If arterial pH drops below 7.35, we say the person's blood is too acidic and that they are in a state of acidosis. Conversely, if arterial pH is above 7.45, we say the person's blood is too basic and that they are in a state of alkalosis. Generally, a person cannot survive for more than a few minutes if arterial pH drops below 6.8 or rises above 8.0.

The primary challenge that the body faces daily is the production of excess acids. These acids can be classified into two broad categories, volatile acids and non-volatile acids. Volatile acids are CO_2 and acids that can be converted to CO_2 . We produce about 15,000 millimoles of volatile acids daily, mostly as a result of the breakdown of nutrients. However, all of the volatile acids can be removed by the lungs. Volatile acids do not present a problem to us as long as the lungs are functioning properly. Non-volatile acids, on the other hand, cannot be excreted by the lungs. Non-volatile acids include lactic acid, ketoacids, sulfuric acid and phosphoric acids as well as acids consumed in our diets. On average, the body must deal with about 70 mmol of non-volatile acids each day. Since these acids cannot be excreted by the lungs, they must be eliminated by other means. Under normal conditions, our body does an admirable job of handling the acid (and base) challenges it faces. In dealing with these challenges, we have three lines of defense; 1) buffers, 2) the respiratory system and, 3) the kidneys. We will examine each of these defenses and then discuss what happens when something goes wrong.

Buffers
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