



The Lactic Acid System

(Related words: anaerobic glycolysis; anaerobic lactate system; glycolysis, glycolytic system; lactacid system, lactate, lactic acid, lactic acid tolerance training).

The lactic acid system is an anaerobic energy system in which the high-energy compound adenosinetriphosphate (ATP) is manufactured from the breakdown of glucose to pyruvic acid in the muscle cells. In the course of the process, known as anaerobic glycolysis (the splitting of sugars), chemical energy is released and used to synthesise two ATP molecules for each glucose molecule metabolised.

During high-intensity activities, such as sprint races, lasting up to about two minutes or for the first 40 seconds or so of less intensive exercise (before the aerobic metabolism has been fully activated), the body uses the lactic acid system for energy.

The pyruvic acid that is produced is converted to lactic acid ($C_3H_6O_3$), which very quickly dissociates into hydrogen ions and lactate. The end-product of glycolysis under aerobic conditions is pyruvate, a salt or ester of pyruvic acid.

Lactic Acid and Lactate

Because the process of creating lactate involves a brief intermediate step in which lactic acid exists, the terms are often used interchangeably. But they are not the same: lactic acid is an organic acid that exists for such a short period in the body that it cannot be isolated or measured, while lactate is an acid salt that accumulates in the body, and this build up can be measured. The distinction is important not only for the sake of correctness but, more importantly, because lactate and lactic acid have different physiological effects.

Associated Myths

Many think that lactic acid or lactate cause muscle stiffness and limit performance in running events. Neither is correct. Perhaps the most widely believed myth is that an accumulation of lactic acid or lactic acid crystals or lactate is the cause of the stiffness felt after a marathon or long run. This stiffness is due mostly to damage to the muscle. Lactic acid exists only momentarily and thus neither it nor lactic acid crystals can accumulate in the body. The lactate released from the muscle is converted in the liver to glucose, which is then used as an energy source by the muscles during prolonged exercise. So, it actually helps to delay a possible lowering of blood glucose concentration, a condition called hypoglycemia that will cause a runner to feel weak and fatigued if it occurs.

Another misconception is that lactic acid or lactate are responsible for acidifying the blood (acidosis), thereby causing the burn felt in intense exercise or the fatigue at the end of the 400m and creating the need for lactic acid tolerance training or LATT. This belief arises because the level of lactate measured after intense exercise is high when the blood is acidic. The real cause of acidosis is that every time an ATP molecule is split for energy, a hydrogen ion (known as a proton) is released and the accumulation of these lowers the blood pH making it acidic. Pyruvate molecules bond with protons to form lactate. Thus, lactate is a consequence of acidosis, rather than the cause, and it actually keeps the acid level from becoming greater.

Sources: M. Kent (2006). Oxford Dictionary of Sport Science and Medicine (3rd ed.). Oxford: Oxford University Press; S. Jennett (2008). Churchill Livingstone's Dictionary of Sport and Exercise Science and Medicine. Edinburgh: Elsevier; G. Thibault & F. Péronnet (2006). It is not lactic acid's fault. *New Studies in Athletics*, 21(1), pp. 9-15; http://www.time-to-run.com/the_abc/lactic.htm, <http://www.unm.edu/~lkravitz/Article%20folder/lactate.html>.