

# ABSTRACT

## Lactate is a fuel and a signal molecule

Hideo Hatta

Department of Sports Sciences, The University of Tokyo

Lactate has long been recognized as the final and waste product of glycolysis and is then mainly metabolized to glucose in the liver after transportation from skeletal muscle. However, it is now established that lactate is also an intermediate of carbohydrate metabolism and a fuel. Oxidation is the major pathway for lactate metabolism particularly during and after exercise when a great deal of ATP production is required. Fatigue has long been attributed to an accumulation of lactate only, although recent research has shown it may be caused by many other factors. For example, reduced muscle glycogen concentration is a major cause of fatigue during and after endurance type exercise. As lactate is produced mainly from muscle glycogen, its production of lactate is decreased when muscle glycogen is reduced. Therefore, marathon runners get tired towards the end of a race when glycogen become depleted with a concomitant reduction in the production of lactate. Blood lactate concentrations in soccer players during a game have also been shown to be reduced during the latter half of a game. Lactate can counteract a decline in muscle contraction induced by potassium, and therefore can reduce fatigue. Recently it was reported that lactate can also be considered as a signaling molecule that induces various adaptations in tissues. Increased lactate concentration increases mitochondrial biogenesis and histone acetylation to promote changes in gene expression, and can accelerate wound healing and angiogenesis. Therefore, lactate should not be considered as a waste product, but rather as a substrate of oxidation and a signal molecule that induces various adaptations.

**Key words** Lactate, Oxidation, Carbohydrate metabolism, Fatigue