HUMAN LACTATE KINETICS: TRAINING EFFECTS

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by

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ABSTRACT

Blood lactate concentrations are lower at a given exercise intensity following training. The lower blood lactate concentrations have generally been attributed to a reduced rate of lactate production by the active skeletal muscles, but there is a growing body of evidence which suggests that the lower blood lactate concentrations may be due to an increased rate of lactate removal. The work described in this thesis used a variety of experimental manipulations to examine the effects of endurance exercise training on whole body blood lactate removal, and the production and removal of blood lactate by skeletal muscle.

A method for comparing rates of blood lactate removal between endurance-trained and untrained subjects during recovery from exercise was validated and used to compare lactate removal in endurance-trained and untrained cyclists during recovery from supine cycling exercise. It was found that the endurance-trained subjects not only exhibited lower blood lactate concentrations at a given work load during exercise, but they also demonstrated an increased rate of lactate removal during recovery compared with the untrained subjects. These findings were interpreted as indicating that the lower blood lactate concentrations in the trained subjects during exercise were, at least partly, due to an increased rate of blood lactate removal.

It had been suggested that trained skeletal muscle is the most likely site of increased lactate removal in endurance-trained subjects. To examine whether trained skeletal muscle does possess an increased ability to remove

lactate from the blood in comparison to untrained skeletal muscle, lactate removal by endurance-trained and untrained forearm skeletal muscle was compared during incremental venous sodium lactate infusion. No difference in lactate removal was found between trained and untrained skeletal muscle, suggesting that the increased lactate removal in trained subjects is not due to localised adaptations in the trained skeletal muscles.

Inactive skeletal muscle is a recognised site of blood lactate removal during exercise, and the possibility that systemic adaptations to training might increase lactate removal by inactive skeletal muscle during exercise, through the provision of a more favourable internal milieu, was investigated. Lactate removal by inactive untrained forearms was compared in endurance-trained and untrained cyclists during incremental supine cycling exercise and recovery. Rather than increasing lactate removal, systemic adaptations to training reduced the removal of lactate from the blood by inactive skeletal muscle. This was a result of adaptations in other tissues which served to lower blood lactate concentrations, thereby reducing the uptake and metabolic disposal of lactate by inactive skeletal muscle.

A decreased rate of net lactate output by trained compared with untrained forearms had been observed during handgrip exercise, and the question of whether the lesser net lactate output could be due to a decreased rate of lactate production, resulting from an increased utilisation of plasma FFA, was addressed. Trained and untrained forearms performed incremental handgrip exercise, and the trained forearms demonstrated a significantly lower net lactate

output at a given work load in comparison to the untrained forearms. The lesser net lactate output by the trained forearms occurred despite there being no differences in net plasma glucose or plasma FFA uptake between the two groups, and was attributed to a reduced glycogenolytic rate, probably resulting from an increased utilisation of FFA derived from some source other than the plasma.

In summary, this thesis has provided evidence that endurance training does not increase the ability of skeletal muscle to remove lactate from the blood, and that the lower blood lactate concentrations during exercise in the trained state result from the combination of a reduced rate of lactate production by the trained skeletal muscles and an increased rate of lactate removal by some tissue other than skeletal muscle.