



1: [J Appl Physiol.](#) 1989 Jul;67(1):123-7.

[Links](#)

NADH shuttle enzymes and cytochrome b5 reductase in human skeletal muscle: effect of strength training.

[Schantz PG](#), [Källman M](#).

Department of Physiology III, Karolinska Institute, Stockholm, Sweden.

The main aim of this study was to investigate whether enzyme levels of the malate-aspartate and alpha-glycerophosphate shuttles and of cytochrome b5 reductase in human skeletal muscle are affected by strength training. Muscle biopsy samples from the deltoid muscle of the nondominant arm in untrained (n = 12) and strength-trained (n = 12) subjects were compared. The strength-trained muscles were characterized by a tendency to a higher percentage of type I fibers (67 vs. 59%), a lower percentage of type IIb fibers (12 vs. 18%), 34% larger mean fiber areas, and 19% more capillaries per fiber (P less than 0.1). No difference was noted in levels of enzymes representing the citric acid cycle, fatty acid oxidation, and glycolysis, nor in the number of capillaries per square millimeter. Neither did the levels of malate-aspartate and alpha-glycerophosphate shuttle enzymes nor cytochrome b5 reductase differ. Levels of cytochrome b5 reductase correlated ($r = 0.59$, P less than 0.01) with levels of the mitochondrial marker enzyme citrate synthase. It is concluded that strength training does not appear to result in increased levels of NADH shuttle enzymes and cytochrome b5 reductase.