

Influence of chronic food deprivation on structure-function relationship of juvenile rat fast muscles

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Abstract

In the present study, we analyze the influence of chronic undernutrition on protein expression, muscle fiber type composition, and fatigue resistance of the fast extensor digitorum longus (EDL) muscle of male juvenile rats (45 ± 3 days of life; $n = 25$ and 31 rats for control and undernourished groups, respectively). Using 2D gel electrophoresis and mass spectrometry, we identified in undernourished muscles 12 proteins up-regulated (8 proteins of the electron transport chain and the glycolytic pathway, 2 cross-bridge proteins, chaperone and signaling proteins that are related to the stress response). In contrast, one down-regulated protein related to the fast muscle contractile system and two other proteins with no changes in expression were used as charge controls. By means of COX and alkaline ATPase histochemical techniques and low-frequency fatigue protocols we determined that undernourished muscles showed a larger proportion (15 % increase) of Type IIa/IIc fibers (oxidative- glycolytic) at the expense of Type IIb (glycolytic) fibers (15.5 % decrease) and increased fatigue resistance (55.3 %). In addition, all fiber types showed a significant reduction in their cross-sectional area (slow: 64.4 %; intermediate: 63.9 % and fast: 61.2 %). These results indicate that undernourished EDL muscles exhibit an increased expression of energy metabolic and myofibrillar proteins which are associated with the predominance of oxidative and Type IIa/IIc fibers and to a higher resistance to fatigue. We propose that such alterations may act as protective and/or adaptive mechanisms that counterbalance the effect of chronic undernourishment. © 2013 Springer Science+Business Media Dordrecht.

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Keywords

EDL muscle, Glycolytic fibers, Muscle fatigue, Oxidative fibers, Undernutrition