There is no difference in the net efficiency of fast- and slow-twitch mouse muscles

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It is commonly accepted that slow-twitch muscles are more efficient than fast-twitch muscles; that is, slow twitch muscles convert a greater fraction of the energy they use into mechanical work. Evidence supporting this idea comes from two types of experiment. First, humans with a greater fraction of slow-twitch fibres are more efficient when cycling on an ergometer (Coyle *et al.*, 1992) and, second, isolated preparations of slow-twitch muscle use less high energy phosphate per unit work performed than fast-twitch preparations (Barclay, 1996). The human experiments have the drawback that it is difficult to make inferences about muscle efficiency from measurements of whole body O_2 consumption. The isolated muscle experiments are difficult to relate to *in vivo* efficiency because: (1) efficiency was measured only during shortening, rather than over complete cycles of shortening and lengthening; and (2) because the indices of energy cost used did not encompass oxidative recovery processes. In the only study comparing efficiency of fast and slow muscles that used cyclic contractions and in which O_2 consumption was used as the index of energy use, slow-twitch rat muscles were found to be less efficient than fast-twitch muscles (Heglund & Cavagna, 1987). However, that study used a temperature of 20°C rather than physiological temperature.

The aim of this study was to measure efficiency of isolated fast- and slow-twitch muscles using a pattern of activity similar to that occurring *in vivo*, using the energetic equivalent of O_2 consumption as the index of energy cost and performing the experiments at a temperature of 35°C.

Experiments were performed *in vitro* using bundles of muscle fibres from the slow-twitch soleus and fast-twitch EDL muscles of mice. Muscles were dissected from mice that had been killed by inhalation of CO_2. Efficiency was calculated from measurements of work output and total heat production during and after a series of 20 contractions. The contraction protocol consisted of a realistic, cyclic pattern of muscle length changes with a brief contraction in each length cycle. Twenty contractions were performed at a frequency of 3.4 Hz. Net mechanical efficiency was defined as the ratio of work output to the total, suprabasal enthalpy output and enthalpy output was the sum of the heat and work output.

There was no difference in the maximal net efficiency of fast- and slow-twitch mouse muscles. Maximum efficiency of soleus muscles was 13.9 ± 0.8 % ($n = 6$) and of EDL muscles was 13.5 ± 0.5 % ($n = 6$).

This result suggests that any relationship between human efficiency and fraction of slow-twitch fibres is not a reflection of an intrinsic difference in efficiency of fast and slow muscle fibres.

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