HEADING SPACE

RESYNTHESIS OF ATP IN GLYCERINATED FIBRES STRETCHED DURING CONTRACTION

J.M. Gillis and G. Maréchal (Laboratoire de Physiologie Générale, Louvain, Belgium)

ABSTRACT

A contracting muscle produces work and heat by deriving its energy from the hydrolysis of ATP. Is this energy coupling reversible i.e. can ATP be resynthesized from ADP and Pi by application of external work during a stretch of a contracting muscle ? Various authors have shown that the energy expenditure of a muscle stretched during contraction is reduced, when it is measured either by the breakdown of ATP and phosphocreatine, or by the sum (work + heat). These results do not discriminate between a simple reduction of the contractile metabolism and the reversal of the hydrolysis of ATP. In the experiments reported here, 19 bundles of glycerinated rabbit psoas fibres were made to contract in a Mg-ATP solution containing radioactive Pi. The bundles were attached to strain gauges fastened on an ergometer. After 10 sec of isometric contraction, the fibres were slowly stretched during 3 sec and frozen at the end of the stretch. The extracted ATP was separated from Pi by absorption on charcoal, followed by chromatography. The radioactivity of the purified ATP was assayed by liquid scintillation counting. As controls, 20 bundles were treated exactly in the same way, except that they were shortened. Specific activity of the ATP extracted from the stretched fibres was significantly ($P = 0.02$) higher than the one from the shortened fibres. The difference corresponded to a resynthesis of 2.2 pmoles ATP/bundle, or to a gain of 22 ncal of free energy (taking 10kcal/mole as ΔF for the synthesis of one $\sim P$). This gain divided by the work received by the fibres gives the efficiency of the stretch : it amounted to 15 % in our conditions. The results support strongly the hypothesis that the energy coupling of the muscular contraction is a reversible process.