The reversibility of the contraction of myosin threads.

by

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It has been shown in a previous paper (1) that threads of myosin B show a violent contraction if suspended in a solution containing KCl (0,05 M), $MgCl_2$ (0,001 M) and ATP (Adenyltriphosphate 0,17%). If such a contracted thread is washed out with water and supended in a solution containing 0,25 M KCl and 0,001 M $MgCl_2$ no appreciable change is observed. If ATP is added now to the solution the thread swells up within a few minutes to its original size; it becomes transparent and similar to the original uncontracted thread in all respects. If the liquid is replaced by the salt solution in which the contraction was obtained, the thread contracts again. The contraction is thus reversible and ATP is essential not only for the contraction but also for the relaxation. The thread can be brought to contraction and relaxation by the variation of the KCl concentration

Mg is essential for the contraction as well as for the relaxation. In absence of Mg the contraction is sluggish and there is no relaxation at all. Only a very slight swelling is obtained as revealed by the somewhat increased transparency. At higher KCl concentrations (in presence of ATP) the thread desintegrates without much swelling.

The Mg can be replaced by a dialysed extract of the muscle. Whether this action is due to the traces of Mg, possibly bound by the protein, or by some other substance, cannot be stated at present.

In presence of 0,1% quinine the same contraction and relaxation is obtained as in absence of this substance. As shown by I. BANGA this alcaloid greatly inhibits the phosphatase action of myosin. Both the contraction and relaxation can thus take place without the splitting of the ATP.

The same experiment were also repeated with threads prepared from 160% active myosin (see Straub's paper) prepared from myosin A and Actin. The results were similar to those obtained with myosin B with the one difference that in presence of ATP these threads dissolve at a lower KCl concentration. While a myosin B thread contracts still in a 0,15 M KCl solution (in presence of ATP and 0,001 M $MgCl_2$), is inactive in 0,2 M KCl and dissolves in 0,25 M KCl, the thread prepared from the 160% active myosin contracts in 0,05 M KCl, is inactive in 0,1 M KCl and dissolves in 0,15 KCl, is thus more sensitive to the action of this salt. As shown by STRAUB and BALENOVIČ, the myosin of the muscle is about 170% active.

The effect of ATP depends thus on the concentration of the KCl present. But ATP added in form of its K salt may increase the salt concentration sufficiently to convert its own action from a contracting to a dissolving one. This may be illustrated by the following experment: Threads, prepared from 160% myosin were suspended in 0,35 ml. of a 0,05 M KCl solution containing 0,001 M $MgCl_2$. Then 0,05 ml. of an ATP solution were added, containing 1,4% ATP, 0,05 KCl and 0,001 $MgCl_2$. A slow contraction is obtained. In a second experiment the threads were suspended in 0,3 ml of the KCl $MgCl_2$ solution and 0,1 ml of ATP was added. The threads dissolved. The concentration of the ATP thus determines its own effect, whether it will cause contraction or relaxation.

The reversibility of the contraction of myosin threads was also demonstrated by M. GERENDÁS and D. VARSÁNYI in a very neat way. (Oral communication). T. ERDÖS has shown that ATP, in presence of lower concentrations of KCl (+ Mg) causes a contraction of the threads while in presence of higher concentration it causes a dissolution. Between the two ranges of concentration there is a range in which the thread neither contracts, nor dissolves: is inactive. GERENDÁS and VARSÁNYI have shown that such an inactive thread can be brought to a rapid contraction by the simple dilution of the solvent or by the addition of Ca-permutit which binds the K.

Literature.

1. Studies from the Inst. Med. Chem. Szeged. *1* 17, 1941—42.