THE EFFECT OF SUCCESSIVE STRETCHES ON THE X-RAY DIFFRACTION PATTERN IN TETANIZED FROG SKELETAL MUSCLE

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To investigate the effect of successive stretches, the sartorius muscle from a bullfrog was mounted in an experimental chamber filled with Ringer solution (12°C). The tendon of the muscle was connected to a servo-motor and the other end of the muscle was to a tension transducer. The muscles were tetanized for 4.5 s by applying supramaximal current pulses (20 Hz). The contraction was repeated 10 times at an interval of 3 min. The intensity distribution of the X-ray scattering was recorded by an X-ray CCD detector at every 15 ms.

Fig.1 shows the time courses of the integrated intensity of the 2nd (I₂₁₅) and 3rd (I₁₄₃) meridional reflections together with tension and length records when the two successive stretches of different velocities are applied to the tetanized muscle. At the plateau of contraction, the muscle was stretched with velocity 0.15Lo/sec at first, and then further stretched with a much slower velocity (1/10 of the first stretch velocity). The magnitude of the length change in both stretches was the same (1.5%Lo). The tension in tetanized muscle rose continuously during an initial stretch, and began to decay gradually when the 2nd stretch with slower velocity was applied, though the muscle is still being stretched. The I₁₄₃ intensity was found to decrease during the initial rapid stretch and then a recovery of the intensity was seen after the completion of the first stretch. The successive slower velocity stretch also caused the slower decrease in the intensity. In Fig.2 the sequence of change in stretch velocity was reversed, i.e., the muscle was first stretched slowly, and then rapidly stretched. Note that the I₁₄₃ increased little by little at the beginning of the slow stretch, but it started to decrease at the late part of the slow stretch. The successive fast stretch caused a sudden decrease in the intensity followed by a recovery after the completion of the second stretch. The axial spacing of the I₁₄₃ reflection increased by 2% or less. The spacing was not significantly affected by both stretches, and returned to the initial value when the contraction was over.

References
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