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THE EFFECT OF SUCCESSIVE STRETCHES ON THE X-RAY DIFFIRACTION 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 tentanized 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 15ms.

Fig.1 shows the time courses of the integrated intensity of the 2nd (I_{215}) and 3rd (I_{143}) 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 I_{143} 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 I_{143} 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 I_{143} 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.

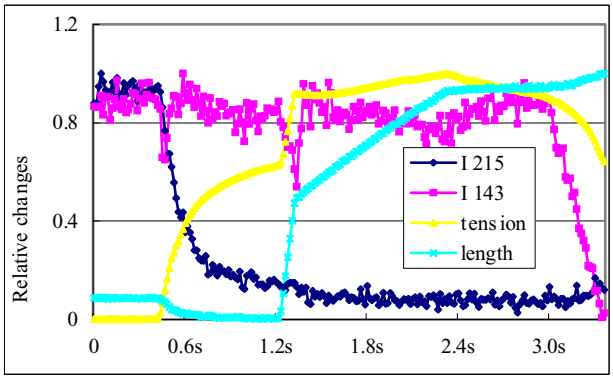

Fig.1. The time courses of the meridional reflections during two successive stretches (fast stretch followed by slow stretch) with tension and length.

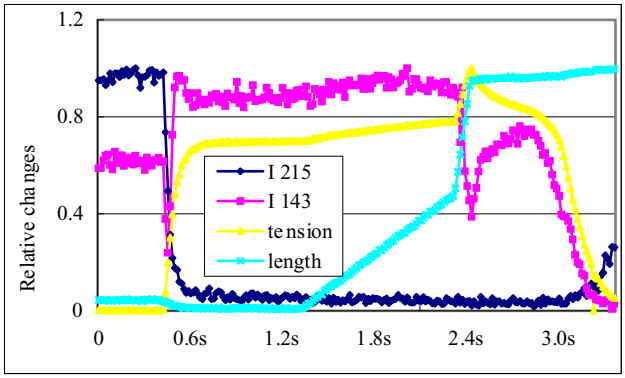

Fig.2. The time courses of the meridional reflections during two successive stretches (slow stretch followed by fast stretch) with tension and length.

References

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