Muscle Fiber Contraction with ATP

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Purpose

Energy, in the form of ATP (Adenosine triphosphate), is necessary for muscle contraction. In living muscle, the ATP is generated "on the spot" for use by individual fibers. In this experiment, you will learn several things:

1. That ATP as a chemical can be applied to preserved fibers, and contraction will result;
2. That the ATP is effective only in the presence of certain salts.
3. That the mechanism for investigating these relationships utilizes the Scientific Method.

Rabbit psoas muscle preserved in 50% glycerol can be frozen and stored almost indefinitely (Could you use this for "deep sleep"?) ATP solutions are refrigerated but should be as fresh as possible when used (Why?).

Procedure

1. Work in groups of 3.

2. Remove from the test tube the stick to which the bundle of muscle has been tied. Pour a little glycerol into a watch glass . With a glass needle tease a just visible piece of muscle from the bundle and use 3 - 5 cm. of length. Drop this into the glycerol in the dish. One piece should be sufficient for each individual or team.

3. Tease the segment of muscle into very thin groups of fibers (muscle cells). Try to get strands as thin as a human hair..

4. Transfer the thin strand and a minimal amount of glycerol on a slide. (Insufficient glycerol and the muscle fiber will dry out and not work, too much will make a mess and get all over – glycerol is very sticky!) Do not cover. Lay it out straight.

5. Use a plastic ruler to measure the length of the strand. Record this data on the worksheet. Work in teams of three with each member doing one preparation.

6. Flood the fibers with several drops of the solution containing ATP plus potassium (K+) and magnesium (Mn++) ions. Observe the reaction of the fibers. After 30 seconds or more, measure again and record. (Member 1)

7. Repeat the experiment, 4 & 5, using new fibers and the solution of ATP alone. Record. (Member 2)

8. Repeat the experiment with new fibers and the solution of salts alone. (Member 3)

Name: _____ Group Member 2 _____

Data Record (3 pt.)

Group Member 3 _____

Striation Spacing *in microns*	**Before** mm	**After** mm	Was there any change in width?
Fibers + ATP + Salts			
Fibers + ATP			
Fibers + Salts			

Briefly **describe and draw** the appearance of the fibers before treatment. (1pt.)

How do they look after contraction? Pay special attention to the spacing of the striations and the smoothness of the sides. **Describe and draw**. (1 pt)

Conclusions (3 pt.)

1. Why was it necessary to try ATP alone and salts alone?

2. What are the technical terms for the three setups used?

3. What conclusions may be drawn from your results?

Discussion (2 pt.)

Compare your data with those of other students. Assuming everyone got positive results with ATP + salts, what additional factors seem to affect the amount of contraction?

Hints: The speed and extent of the reaction are influenced by the amount of glycerol on the slide, the concentration of active ATP, and the width of the muscle strand (Why?). Under favorable conditions, a myofiber can be expected to contract to almost 50% of its starting length within 10 seconds. (Is there a concomitant change in width?)