DATA SET
ELABORATE LESSON 23

Food and Agriculture Center for Science Education

Human skeletal muscle fatty acid and glycerol metabolism during rest, exercise and recovery.

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Overview of the Study

Scientists investigated changes in the concentration of fatty acids (FA) in the bloodstream during extended endurance exercise. To study this, five healthy males in their 20s participated in the investigation. The workout selected for the investigation was one-legged knee extensions on a seated leg extensor machine. Prior to the day of the investigation, participants were able to try out the exercise, and scientists measured each person's max power output.

Study 1

Prior to exercise, catheters were placed in the artery entering the leg muscle and the vein exiting the same leg muscle so that measurements of blood fatty acids could be taken continuously before, during, and after exercise. Participants engaged in the knee extensor exercise for two hours. Blood samples were taken from the participants at rest, then after 30, 60, 90, 105, and 120 min of one-leg knee-extensor exercise at 65 % of maximal single-leg power output, and every 30 minutes during the 3 hours after recovery. Blood samples were analyzed to determine their fatty acid concentrations.

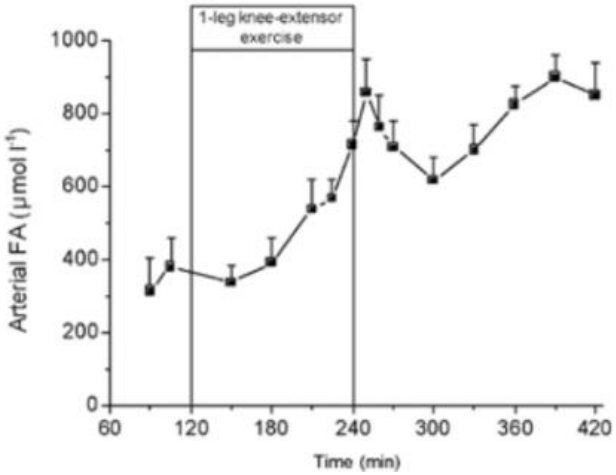

Figure Caption:
Arterial FA concentration during rest, exercise, and recovery. Values are means ± s.e.m. of five subjects.

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Study 2

In the same research program, scientists also investigated the extent to which fatty acids (FA) in the bloodstream during exercise were taken up into muscles. To study this, scientists used the same exercise protocol as in Study 1. Catheters were placed in the vein entering the leg muscle and the vein exiting the same leg muscle so that measurements could be taken continuously before, during, and after exercise. Participants engaged in the knee extensor exercise for two hours. Blood samples were taken from the participants at rest, then after 30, 60, 90, 105, and 120 min of one-leg knee-extensor exercise at 65 % of maximal single-leg power output, and every 30 minutes during the 3 hours after recovery. Blood samples were analyzed to determine their fatty acid concentrations, and the amount of fatty acids entering the muscle tissue was calculated using a mathematical formula.

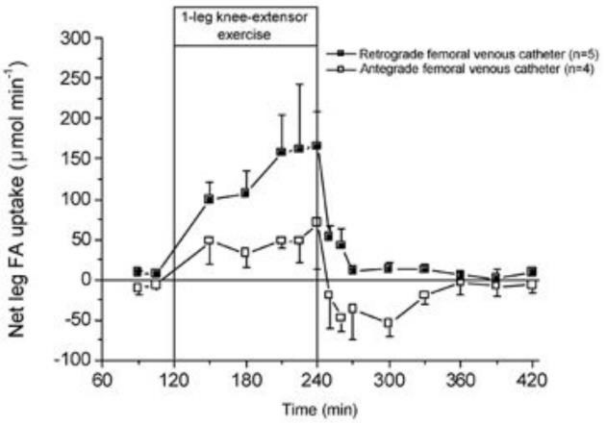

Figure Caption:

■ FA kinetics when using femoral venous FA data from the femoral venous catheter in the retrograde position (n = 5), which excludes, to a large extent, contamination from subcutaneous adipose tissue (van Hall et al. 1998). □, FA kinetics when using femoral venous FA data from the femoral venous catheter in the commonly used antegrade direction (n = 3).

Study 3

In the same research program, scientists also investigated the extent to which fatty acids (FA) in the bloodstream during exercise were used by the muscles to produce ATP for the muscles. To measure this, scientists measured the amount of carbon dioxide produced as muscles used fatty acids in an energy-producing process called fatty acid beta oxidation. This chemical reaction uses fatty acids to produce ATP for muscle cells (and other cells in the body).

To study this, scientists used the same exercise protocol as in Studies A and B. Participants engaged in the knee extensor exercise for two hours. Prior to exercise, participants had fatty acid molecules with isotopic carbon tracers added to their bloodstream via an injection. This tracer carbon in the fatty acid molecules could then be measured in exhalations to determine how many of the carbon molecules in the fatty acid underwent metabolic chemical reactions to be converted into CO_2 during exercise. During exercise, participants wore masks that collected their exhaled breath to measure the amount of CO_2 exhaled.

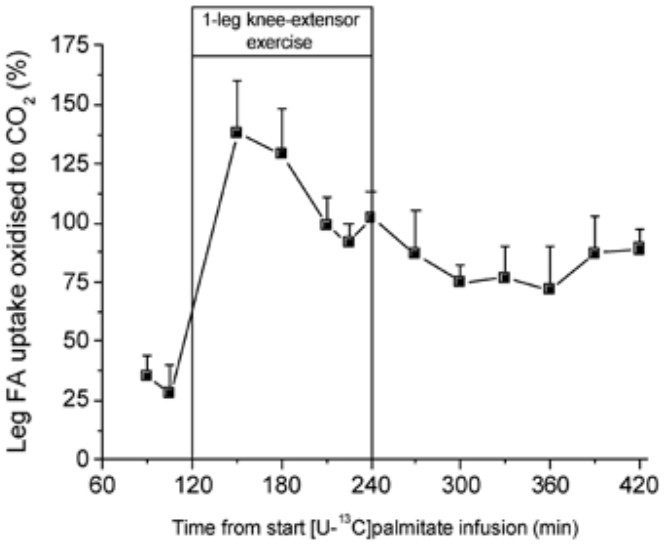

Figure Caption:
Values are means ± s.e.m. of five subjects. The leg FA uptake oxidized to CO_2 is estimated only from the data from the retrograde femoral venous catheterization.