Activity 36 Fatty Acid Degradation and Glucose Synthesis

PRE-ACTIVITY ASSIGNMENT

2. From succinate to fumarate to malate to OAA appear identical to FA degradation including electron carriers.
3. The carbons from labeled palmitate enter the TCA cycle through acetyl CoA and condense with OAA to form citrate. The carbons that originated from acetyl CoA are not removed during the first turn of the TCA cycle therefore if OAA molecules containing the C^{14} label were used to synthesize glucose, the glucose would contain C^{14}. However since acetyl CoA (derived from palmitate) only provided two carbons to the cycle and two carbons are removed as CO_2, no net carbons were provided from palmitate and therefore palmitate is only used to make CO_2 not glucose.

IN-CLASS ACTIVITY

Critical Thinking Questions

1. Palmitate → dehydrogenation → hydrated across double bond → OH is oxidized to =O then a two carbon fragment is removed. This is done 7 times generating 8 acetyl CoA molecules → 16 CO_2 in TCA
2. The same except that the reaction is done 7 times generating 7 acetyl CoA and 1 propionic CoA. The former enter the TCA and the latter is made into succinyl CoA and enters at succinate.
3. Since acetyl CoA (derived from palmitate) only provides two carbons to the cycle and two carbons are removed as CO_2, no net carbons were provided from palmitate and therefore palmitate is only used to make CO_2 not glucose. The OAA carbons could be used to make glucose, but two OAA are needed to make one glucose.
4. FROM ASSIGNMENT The carbons from labeled palmitate enter the TCA cycle through acetyl CoA and condense with OAA to form citrate. The carbons that originated from acetyl CoA are not removed during the first turn of the TCA cycle therefore if OAA molecules containing the C^{14} label were used to synthesize glucose, the glucose would contain C^{14}. However since acetyl CoA (derived from palmitate) only provided two carbons to the cycle and two carbons are removed as CO_2, no net carbons were provided from palmitate and therefore palmitate is only used to make CO_2 not glucose.
5. Because the propionic acid enters as succinate after all the carbons are lost as CO_2. Therefore all carbons that enter can be removed as OAA and not diminish the cycle intermediates.
6. 0.5 mole since each palmitate produces one 3 carbon fragment of propionyl CoA and you need two 3-carbon fragments to make glucose.
7. Without the many copies of glycolysis enzymes we would not be able to make ATP fast enough to exert our muscles to sprint. The large capacity of glycolysis allows us to sprint when needed for safety.
8. By inhibiting FA degradation oxygen is not completely used up therefore the pain caused from limited oxygen diminishes.
9. Fat → CO_2 + H_2O. When oxygen combines with the electrons from ETC and protons water is made. Some water goes into beta-oxidation of fats and subsequent metabolic steps, but more is produced.
10. Augmented-more copies of the enzymes are made and probably more mitochondria as well

    Ability to extract oxygen-since oxygen is used by an enzyme, cytochrome oxidase, in the mitochondria there must be more of this around

    They use it faster-again more copies of everything (enzymes, mitochondria) means speed

Do not train the aerobic enzyme systems—strength training does not develop additional copies of enzymes or increase numbers of mitochondria

POST-ACTIVITY SKILL EXERCISES

1. $\Delta G^{o\prime}$ for glucose is: - 2850 kJ/mol, which is -475 kJ/mol carbon

   $\Delta G^{o\prime}$ for palmitate is: - 9781 kJ/mol, which is -611 kJ/mol carbon

   Theoretical:

   If we assume that $\Delta G^{o\prime}$ for ATP formation is 30 kJ/mol then:

   Glucose yields 475/30 = 15 ATP/carbon

   Palmitate yields 611/30 = 20 ATP/carbon

2. 1 glucose has been shown to yield 32-38 ATP's , which is 5.3-6.3 ATP/carbon

   1 palmitate has been shown to yield 129 ATP's or about 8 ATP/carbon.

3. Standard conditions differ from cellular conditions. Also biological reactions, like reactions in a test tube, do not reach 100% yield.

4. By considering calculations in both 1 and 2 above, we can see that more ATP/carbon are produced when lipids are metabolized as compared to glucose.