Abstract

Currently we are conducting ongoing research to study the effects of the chemical curcumin on lactate release in rat adipocytes at different concentrations of glucose. Our previous experiment showed that curcumin can inhibit the uptake of glucose into cells, which results in a decreased lactate output. The mechanism of the inhibitory effects of curcumin on glucose uptake is currently unknown. Research conducted by Dr. Green suggests that the action of curcumin is a result of direct inhibition of basal and insulin-stimulated glucose transport. We are now investigating whether curcumin functions as a competitive inhibitor of glucose uptake into fat cells. To observe the proposed relationship, we must use lower concentrations of glucose than previously studied. Since our previous work used higher concentrations of glucose, we will be repeating our experiment at lower concentrations and interpreting the results of our lactate assay. A challenge of this study will be measuring the lactate production at such low concentrations through spectroscopy. Finally, though curcumin can never be directly used in humans (because it does not get absorbed into the blood stream) it can serve as a potential model from which further research can be conducted.

Introduction

Type 2 Diabetes mellitus
- Affects 346 million people worldwide
- WHO projects that diabetes deaths will double between 2005 and 2030
- Healthy diet, regular physical activity, maintaining a normal body weight and avoiding tobacco use can prevent or delay the onset
- Characteristic of insulin resistance
- Curcumin is a component of the spice turmeric, commonly used in curry
- Previously shown to inhibit glucose uptake in adipocytes
- Inhibited glucose may then be taken up by muscle cells
- Potential model for glucose inhibition in adipocytes

Methods

• Dissect lab rat and extract epididymal fat pads for study
• Combine fat with solution of collagenase and digestion buffer and incubate for 45 minutes
• Prepare sets of test tubes containing buffer with curcumin
• Following the incubation period, wash fat cells with fat cell buffer and centrifuge
• Combine fat cells and buffer with different concentrations of glucose
• Separate fat cell buffer mixture into prepared test tubes containing buffer with curcumin
• Incubate samples and use heat bath to stop the reaction
• Prepare and run both glucose and lactate assay
• Measure the absorbencies of the samples and standards of both glucose and lactate using a spectrophotometer
• Use results to calculate the percentage of glucose taken up and respective lactate produced by fat cells
• Repeat experiment at different concentrations of glucose

Conclusion

• Type 2 Diabetes is characteristic of insulin resistance
• Type 2 Diabetes is characteristic of a decreased rate of glucose uptake
• Causes elevated blood glucose levels (BGL), which can lead to hyperglycemia
• Hyperglycemia can lead to the release of free fatty acids (FFAs)
• FFAs worsen obesity and can increase insulin resistance
• Insulin resistance prevents glucose transport to muscle cells during physical activity
• FFAs also promote glucose production by the liver, further elevating BGL
• Previous studies have shown curcumin to have inhibitory properties on glucose uptake in adipocytes, which suggests curcumin could decrease the amount of glucose taken up by adipocytes
• Glucose could then be used to fuel muscle cells

Objectives:
• Measure glucose taken up by adipocytes
• Measure lactate produced by adipocytes
• Quantitatively determine amount of glucose converted to lactate
• Manipulate glucose uptake with the spice curcumin

Figure 2 displays an image of the curcumin experiment being conducted

Results

Figure 3- Effect of Insulin

Figure 4- Lactate Output

Figure 10- Lactate Produced

Figure 11- Lactate Output

Figure 12- Lactate Output

Future Directions

As shown above, measuring low concentrations of lactate has been a challenge, and further improvements of our lactate assay must be made to produce consistent, replicable results. Curcumin does not get absorbed directly into the blood stream, however, this study serves as a potential model for activity in the intestines where curcumin can be present in humans. This model would serve to display the effects of inhibitory chemicals on the uptake of glucose and production of lactate by adipocytes, as well as the effect on glucose uptake in muscle cells.

References