

High Fat Diet Rich in Saturated Fatty Acids, but Not Monounsaturated Fatty Acids, Impairs Glycogen Preservation after Adiponectin Treatment

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ABSTRACT

High fat diet (HFD) is associated with the progression of obesity, type 2 diabetes and diminished insulin sensitivity, which is characterized by a lower glucose uptake and glycogen synthesis capacity in skeletal muscle. Adiponectin (Ad), on the other hand, is a cytokine secreted by adipose tissue that promotes glucose uptake and fatty acid oxidation in skeletal muscle. **PURPOSE:** To determine the effects of Ad on skeletal muscle glycogen, GLUT 4, mitochondrial and lipid content in animals fed with a HFD but with alterations in dietary fatty acids (mixed fat western diet and predominately monounsaturated fatty acid). **METHODS:** Male Sprague Dawley rats were fed a Western-style (21% fat) HFD for 9 weeks to induce obesity then, for 6 weeks, continued the mixed fat Western diet (WD) (9.8% saturated fat; 7.7% mono; 3.5% poly; n=8) or a HFD high in monounsaturated fatty acids (MUFA) (21% fat; 17.76% mono; 1.8% poly; n=8). A control group followed a 15-week standard Chow diet (CD) (4.8% fat; 0.74% saturated fat; 2% mono; 1.77% poly; n=9). Right and left hind-leg extensor digitorum longus (EDL) muscles were incubated in an organ bath (containing Krebs-Henseleit buffer with 2000 mg/L glucose, without calcium chloride and sodium bicarbonate) with or without 0.1 mg/ml Ad for 30 minutes. Glycogen content in the EDL muscle was measured by using periodic acid-schiff staining, while GLUT 4 protein content was measured using rabbit polyclonal antibody against GLUT 4 (ab654), mitochondrial content was measured using a mouse polyclonal antibody against COX 4 protein (ab14744) and lipid content was measured using BODIPY 493/503, using immunohistochemistry techniques. Images were quantified with ImageJ software. **RESULTS:** The Ad incubation resulted in a decrease in muscle glycogen content in animals fed with WD (4.85 ± 0.13 to 4.29 ± 0.11 AU; $p=0.05$). This decrease in glycogen content in the WD group was significantly different compared to a better preservation of glycogen in both CD ($p=0.04$) and the MUFA diet groups ($p=0.012$) (CD: 0.11 ± 0.071 AU; WD: -0.25 ± 0.14 AU; MUFA: 0.18 ± 0.05 AU; one way ANOVA, $p=0.01$). Animals fed with CD tended to have a better preservation of lipid content compared to animals fed with WD ($p=0.07$) and a diet high in MUFA ($p=0.09$) (CD: 25.93 ± 11.2 AU; WD: -21.09 ± 14.81 AU; MUFA: 25.97 ± 16.17 AU; one way ANOVA, $p=0.06$). There were no significant changes in GLUT 4 and mitochondrial content regardless of diet and adiponectin incubation. **CONCLUSIONS:** Animals fed with a western style HFD rich in saturated fat show an impaired response to adiponectin induced increase/preservation of glycogen in skeletal muscle compared to a chow diet, as well as a HFD rich in MUFA. Diets high in saturated fatty acids may have an impaired response to adiponectin treatment.