Phytic acid and myo-inositol support adipocyte differentiation and improve insulin sensitivity in 3T3-L1 cells.

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OBJECTIVE: Phytic acid, also known as myo-inositol hexaphosphate, has been shown to lower blood glucose levels and to improve insulin sensitivity in rodents. We investigated the effects of phytic acid and myo-inositol on differentiation, insulin-stimulated glucose uptake, and lipolysis of adipocytes to test the hypothesis that the antidiabetic properties of phytic acid and myo-inositol are mediated directly through adipocytes.

METHODS: 3T3-L1 cells were treated with 10, 50, or 200 μmol/L of phytic acid or myo-inositol. Oil Red O staining and an intracellular triacylglycerol assay were used to determine lipid accumulation during adipocyte differentiation. Immunoblotting and real-time polymerase chain reaction (PCR) were performed to evaluate expression of transcription factors, a target protein, and insulin signaling molecules.

RESULTS: Phytic acid and myo-inositol exposures increased lipid accumulation in a dose-dependent manner ($P < .01$). The expression of key transcription factors associated with adipocyte differentiation, such as peroxisome proliferator-activated receptor $\gamma$ (PPAR$\gamma$) and sterol regulatory element-binding protein 1c, and the expression of fatty acid synthase increased upon treatments with phytic acid and myo-inositol ($P < .05$). Insulin-stimulated glucose uptake in mature adipocytes increased with phytic acid and myo-inositol treatments ($P < .01$). In addition, mRNA levels of insulin receptor substrate 1 (IRS1), mRNA levels of glucose transporter 4, and phosphorylation of tyrosine in IRS1 increased upon phytic acid and myo-inositol treatments. In fully differentiated adipocytes, phytic acid and myo-inositol reduced basal lipolysis dose dependently ($P < .01$).

CONCLUSION: These results suggest that phytic acid and myo-inositol increase insulin sensitivity in adipocytes by increasing lipid storage capacity, improving glucose uptake, and inhibiting lipolysis.

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