Public Abstract
First Name:Matthew
Middle Name:William
Last Name:Richard
Adviser's First Name:Pamela
Adviser's Last Name:Hinton
Co-Adviser's First Name:
Co-Adviser's Last Name:
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Department:Nutrition Area Program
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Title:Effects of Soy Protein Isolate and Milk Protein Isolate on Metabolic Health and Bone Outcomes in Sedentary, Adolescent Male OLETF Rats

Background: Obesity is a growing epidemic and it is associated with a variety of chronic diseases. Recently, it has been recognized that excess adiposity and associated metabolic dysregulation during skeletal growth may also negatively affect bone health. The spontaneously hyperphagic, Otsuka Long Evans Tokushima Fatty (OLETF rat) has emerged as model for studying the effects of obesity and insulin resistance on skeletal development and maintenance. Traditionally, the consumption of dairy and milk-based proteins has been recommended for the development of strong and healthy bones. In recent years, soy-based proteins have emerged as popular plant-based alternatives. Soy protein, which contains the isoflavone phytoestrogens, reportedly improves metabolic and bone health in postmenopausal women. However, the effect of soy protein on metabolic health outcomes and skeletal development relative to milk protein during skeletal growth has not been investigated. Objective: To examine the effects of isocaloric, isonitrogenous diets containing milk protein isolate (MPI), soy protein isolate (SPI), or a 50/50 combination of the two (MIX) on metabolic health indicators, maximum muscle tension, bone turnover markers, and trabecular, cortical and biomechanical properties of the tibia in spontaneously hyperphagic, insulin resistant, adolescent male OLETF rats. Methods: This was a 16-week study of spontaneously hyperphagic, adolescent male OLETF rats, in which animals had ad libitum access to experimental diets containing MPI, MIX, or SPI. Final body mass, metabolic health indicators, maximum muscle tension and bone turnover markers were measured at ~20-weeks of age (n=9-10 animals per group). Tibia trabecular microarchitecture and cortical geometry were measured by micro-computed tomography (μCT), biomechanical properties were measured by torsional loading, and collagen and AGE content were measured using fluorimetric assays. One-way ANOVA was used to test for significant differences among groups for metabolic outcomes and serum bone turnover markers. One-way ANCOVA with final body weight included as a covariate was used to determine differences among groups for all bone outcomes. A repeated measures two-way ANOVA (time, group) was used to test for significant differences among groups over time for body mass, food intake, calcium, phosphorus and isoflavone intake. Results: At 20 weeks of age, animals in each group were insulin resistant based on fasting glucose and insulin. SPI significantly reduced total serum cholesterol compared to MPI and MIX ($p<0.05$), but did not affect other metabolic health markers, or maximum muscle tension. Fasting insulin was significantly reduced by MPI compared to MIX or SPI ($p=0.006$ and $p=0.001$, respectively). The serum bone formation marker N-terminal propeptide of type I collagen (P1NP) was significantly greater in MIX than in MPI ($p=0.012$), but the resorption marker C-terminal telopeptides of type I collagen (CTx) was not different among groups. P1NP/CTx was significantly greater in MIX than in MPI and SPI ($p=0.006$ and $p=0.017$, respectively). Trabecular spacing (Tb.Sp) of the tibia was significantly reduced in SPI compared to MIX ($p=0.022$), but cortical geometry and tibial biomechanical properties were not different among groups. Conclusions: SPI significantly reduced serum cholesterol concentration and decreased Tb.Sp compared to MIX, while MPI significantly reduced fasting insulin compared to MIX and SPI. These results suggest that a diet containing SPI is not detrimental to metabolic health or skeletal development in spontaneously hyperphagic, adolescent male OLETFs rats, but it might in fact be beneficial for trabecular bone development and maintenance. In addition, these results suggest that a diet containing a combination of animal and plant-based proteins sources, such as MPI and SPI, might promote the most favorable ratio of bone formation to resorption during skeletal growth.