

早稲田大学審査学位論文
博士（スポーツ科学）
概要書

Muscle adaptations to nutritional modulation on rodent models:

High-fat diet regimen and mitochondrial biogenesis

動物モデルでの栄養調節による骨格筋の適応：
高脂肪食とミトコンドリア新生

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早稲田大学大学院 スポーツ科学研究科

李 茜

LI XI

研究指導教員： 樋口 満 教授

Abstract

Studies in experimental animals showed that high-fat diet induces skeletal muscle mitochondrial biogenesis and contributes to the improvement of endurance exercise performance. At the same time, consuming high-fat diet has some disadvantages. A high-fat diet that induces skeletal muscle mitochondrial biogenesis without any accompanying disadvantageous effects will be very beneficial. The objective of the present thesis was to determine the effect of high-fat diet regimen on skeletal muscle adaptation.

Male Wistar rats were fed high-fat diet and control diet on alternate days, or high-fat diet every day, for 4 weeks. The skeletal muscle of rats fed with high-fat diet on alternate days exhibited the same mitochondrial enzyme profiles and protein content as that of the animals fed with high-fat diet for 4 weeks. There was also no difference in the abdominal fat mass was found between alternate-day high-fat diet group and control diet group. These results suggested that high-fat diet on alternate days increases mitochondrial enzyme activities and protein content in rat skeletal muscle without the accumulation of abdominal fat.

C57BL/6 mice were fed a high-fat diet for 4 weeks and then switched to the control diet for another 3 or 7 days. During the high-fat diet withdrawal period, the protein content of the mitochondrial respiratory chain decreased faster than the fatty acid oxidation enzymes. The mitochondrial DNA copy number remained high for at least 1 week after withdrawing high-fat diet. These results suggested that after switching to control diet following a period of high-fat diet, the increased mitochondrial biogenesis levels are maintained for a few days, and the time course of the changes in skeletal muscle mitochondrial protein content is different from that of mitochondrial DNA.

To summarize, the present thesis demonstrated that a high-fat diet administered with appropriate care could be a useful nutritional modulation to induce skeletal muscle adaptations that are beneficial in enhancing endurance exercise performance.