

論文 / 著書情報
Article / Book Information

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種別(和文)	論文要旨
Type(English)	Summary

論文要旨

THESIS SUMMARY

系・コース： Department of, Graduate major in	生命理工学 生命理工学	系 コース	申請学位（専攻分野）： Academic Degree Requested	博士 Doctor of	(理学)
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要旨（英文 800 語程度）

Thesis Summary (approx.800 English Words)

1. Background

Female athletes who endure intense training are at risk of developing the female athlete triad, such as eating disorders, menstrual dysfunction, and osteoporosis, making energy intake management crucial. However, the fluctuations in estradiol and progesterone levels throughout the menstrual cycle present a challenge in maintaining consistent energy intake. This study aimed to uncover the underlying factors associated with appetite regulation linked to menstrual phases and exercise using proteomic approach.

2. Experimental methods

Five female athletes engaged in 60 minutes of bicycle exercise, followed by 90 minutes of rest, during both the follicular and luteal phases. Serum samples were collected before, during, and after exercise, and the serum proteome was analyzed using 2D-gel electrophoresis.

3. Results and Discussion

A total of 511 protein spots were detected in the subjects' serum profiles, with significant decreases observed in haptoglobin during the luteal phase and complement component 3 during bicycle training. Unsupervised classification with a generalized estimating equation analysis showed that serum peptide YY (PYY), an appetite suppressor, significantly influenced the fluctuations of serum proteins induced by exercise ($p < 0.05$). Regression analysis demonstrated a positive correlation between PYY and serum IgM ($R = 0.87$), implying that the intestinal environment and the immune response in female athletes may contribute to appetite regulation. Haptoglobin is a protein known to bind to free hemoglobin released from erythrocytes, and its levels are associated with the loss of complement blood hemoglobin during menstruation, therefore, it is reasonable to observe the increase in haptoglobin levels during the follicular phase, reflecting the normal physiological response. Complement component 3 plays a crucial role in the immune system's complement system, and intense exercise leads to a decrease in post-exercise C3 levels, suggesting that the exercise may activate the classical pathway of complement activation while selectively downregulating C3 synthesis. The observed changes in both haptoglobin and complement component 3 appear to be typical responses to the menstrual cycle and exercise, and may not have a direct impact on appetite regulation. The transitional pattern classification and the generalized estimating equation analysis revealed that PYY may play a crucial role in exercise-induced protein changes. Furthermore, the regression model using PLS revealed a strong association between serum IgM levels and PYY. This finding led us to hypothesize that IgM may act as an autoantibody to modulate the anorexic function of PYY. To validate our hypothesis, we have developed an assay system to quantify the direct binding between IgM and PYY; however, the results did not show any direct binding between IgM and PYY, which prompted us to explore alternative possibilities regarding the correlation between IgM and PYY. In a related study, secretory IgM produced by plasma cells, a type of B cell, located in the gut mucosa, and exhibited a wide range of targets among commensal bacteria, with a particularly strong response to Firmicutes. This discovery provided us with insights to unravel the underlying connection between IgM and PYY. Considering that PYY secretion is triggered by short-chain fatty acids (SCFA) produced by the gut microbiome, and Firmicutes are known to be more efficient in generating SCFA compared to other gut microbiome, the proliferation of Firmicutes in the gut may serve as a stimulant for SCFA production, leading to increased PYY secretion and concurrent stimulation of plasma cells to produce IgM.

備考：論文要旨は、和文 2000 字と英文 300 語を 1 部ずつ提出するか、もしくは英文 800 語を 1 部提出してください。

Note: Thesis Summary should be submitted in either a copy of 2000 Japanese Characters and 300 Words (English) or 1 copy of 800 Words (English).

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