

# 運動とアミノ酸の併用によるマイオカインを介した 褐色脂肪細胞化誘導と肥満予防を超える恩恵への発展

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## **Exercise Combined with Amino Acids Intake Induces Brown-like Adipocyte Formation and Obtains More Benefits Than Just Prevention of Obesity**

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### ABSTRACT

Exercise combined with food-derived factors may have significant effects on the suppression of body fat accumulation. Several trials suggested that amino acid mixtures containing alanine, arginine, and phenylalanine (AA-Mix) combined with exercise can significantly reduce abdominal fat in overweight adults and high-fat diet-induced obesity in mice. We therefore hypothesized that combining AA-Mix and exercise would significantly induce brown-like adipocyte formation, whereas either administration of AA-Mix or exercise alone would not. Administration of AA-Mix (1 g/kg) combined with exercise for 4 weeks significantly induced formation of brown-like adipocytes in inguinal white adipose tissue (iWAT) in mice, although AA-Mix or exercise alone did not. To clarify the mechanism that exercise combined with AA-Mix induces brown-like adipocyte formation, mice were loaded a single acute exercise for 1 h after a single administration of AA-Mix, then the expression of fibroblast growth factor 21 (FGF21) and interleukin-6 (IL-6) were examined. Plasma FGF21 concentration and

the mRNA levels in the liver and iWAT did not differ between the groups after 0 and 1 h of exercise. On the contrary, plasma IL-6 concentration was significantly increased in the exercise combined with AA-Mix group compared with the exercise alone group after 1 h of exercise. These results suggest that IL-6 is involved with exercise combined with AA-Mix induced brown-like adipocyte formation. These findings demonstrate the unique effect of exercise combined with AA-Mix for inducing beige adipocyte formation.

## 要 旨

運動と食品由来因子の併用は体脂肪蓄積抑制などの効果を高める可能性がある。これまでにアミノ酸の混合物（アラニン，アルギニン，フェニルアラニンの混合物；AA-Mix）の摂取と運動の併用はヒトやマウスで体脂肪量を低下させるとの報告があるが，この機構は不明である。著者はマウスにトレッドミルでの運動負荷とAA-Mix（1 g/kg 体重）の投与を4週間実施すると，AA-Mix投与のみ，あるいは運動負荷のみでは褐色脂肪細胞化は誘導されないが，併用することで有意な誘導が認められることを見出した。この機構解明のために，AA-Mixを単回投与後に一過性の運動負荷を行い，その後運動終了直後と終了1時間後のfibroblast growth factor 21（FGF21）と interleukin-6（IL-6）の挙動を調べた。その結果，血漿FGF21濃度や肝臓および白色脂肪組織でのmRNAレベルには群間の差は認められなかったが，血漿IL-6濃度は併用群で運動負荷単独群と比較して運動終了後1時間で有意な上昇が認められた。従ってマイオカインの一つであるIL-6が併用による褐色脂肪細胞化誘導に関与している可能性がある。以上により運動と食品由来因子としてAA-Mixの併用が褐色脂肪細胞化の誘導というユニークな効果を示すことを明らかできた。