Long-term moderate medium-chain fatty acids intake enhances muscle metabolism and function in mice

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[Background]

Medium-chain fatty acids (MCFA) are fatty acids with 6 to 12 carbon atoms. Compared to long-chain fatty acids (LCFA), MCFA is metabolized rapidly, quickly absorbed into the portal vein, and transported to the liver. Their ability to diffuse through cell membranes accelerates their metabolism, making them a more direct energy source.

Studies have shown that MCFA intake can improve exercise capacity and muscle strength in animals and humans, with dose-dependent effects. However, existing research is mainly limited to low-dose or low-proportion applications, and the impact of high-dose MCFA intake within the safe range on various physiological processes still lacks sufficient study.

This study aims to compare the highest proportion of MCFA intake in current high-fat diet research with an even higher proportion within the safe range; exploring the effects of a higher proportion of MCFA intake on obesity inhibition, exercise capacity, muscle and lipid metabolism, and inflammatory responses.

[Experimental Methods]

34 male C57BL/6NCrSlc mice were divided into 4 groups: control (low-fat diet, C group) and 3 MCFA treatment groups (high-fat diets with varying MCFA content; L group, 30%, w/w; M group, 35%, w/w; H group, 40%, w/w). The experiment lasted 12 weeks.

Measurements included submaximal endurance exercise capacity, grip strength, plasma biochemical

parameters, and tissue weights. Gastrocnemius muscle and liver samples were collected for histological analysis, real-time quantitative PCR, and Western blotting.

[Results]

Compared to the L group, the M group showed the best performance in grip strength and exercise capacity, while also exhibiting increased expression of muscle satellite cell proliferation genes and decreased expression of atrophy-related ubiquitin-proteasome pathway genes. The M group also significantly improved myosin heavy chain expression and muscle fiber cross-sectional area. In contrast, the H group showed fewer benefits and even negative effects.

[Discussion]

Moderate MCFA intake may benefit muscle function and metabolism, possibly through the upregulation of myogenic factors and inhibition of muscle protein degradation. However, the study emphasizes the importance of appropriate dosage, as excessive MCFA intake may lead to unfavorable outcomes. The mechanisms behind these effects are not fully understood and warrant further investigation. Future research should focus on exploring MCFA's impact on energy and glucose metabolism and its effects during exercise. The study's limitations include the lack of an obese control group and the collection of samples only at rest.

[Conclusions]

Moderate MCFA intake improves muscle metabolism and function by upregulating muscle regulatory factors and inhibiting protein degradation. However, excessive intake may harm weight control and lipid metabolism.