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Lysine and Threonine Restriction Reproduced the Lower Synthesis but Not the Higher Catabolism of Liver and Muscle Protein of Severely Protein Restricted Growing Rats

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Objectives: The availability of indispensable amino acids (IAA) modulates protein turnover. More particularly AAI deficiency reduces protein synthesis while the consequence on proteolysis remains unclear. The present study aims to evaluate the specific response of both protein synthesis and proteolysis to a diet restricted on one strictly indispensable IAA, either lysine or threonine

Methods: Sixty-four growing rats were divided into 8 groups (n = 8/group). They were fed for 3 weeks isocaloric diets composed with different levels of lysine or threonine (L or T), 15, 25, 40, 60, 75, 100 or 170% of the theoretical lysine/threonine requirements. At the end of the experiment, rats were injected with valine^{13}C and tissues and biological fluids were collected for gene expression measurement and blood amino acids (AA). Protein synthesis rate (Fractional and Absolute rate synthesis, ie FSR, ASR) were determined in liver and muscle. Statistical analysis was done by 1- or 2-factor ANOVA, when data were repeated.

Results: Severe (L/T15, L/T25) and moderate (T40) lysine or threonine deficiency resulted in a decrease in body weight gain due to a decrease in lean body mass. Severe restriction (L15, T15, T25) decreased the muscle FSR whereas no effect was observed in the liver. When the rate of protein synthesis was expressed per tissue, the ASR was decreased by severe restriction of lysine and threonine in liver and muscle and by moderate threonine deficiency (T40, T60, T75) in muscle. In liver, no effect of lysine and threonine on proteolysis was observed. In muscle, only severe lysine (L15) deficiency increased proteolysis. Dietary lysine deficiency induced a decrease in lysine concentration in the portal vein and in the vena cava whereas for threonine deficiency, all AAIs except threonine were decreased in the portal vein and vena cava.

Conclusions: These results indicate that the decreased protein synthesis is the primary mechanism involved in decreased lean body mass in response to the severe deficiency in a single AAI. Deficiency of a single AAI reproduce the effect of the low protein diet on protein synthesis. Lysine and threonine deficiency differently affect for a part protein turnover probably in relation with the tissue where they are metabolized.

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