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A dietary supplementation in antioxidants and leucine during and after immobilization allows an accelerated recovery of muscle mass in adult rats

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Introduction

Bed rest or inactivity result in muscle wasting (Phillips et al, 2009). Besides the alteration of physical performance associated with immobilization, the reduction of muscle mass leads also to an overall reduction of organism defenses. Muscle is indeed an important store of amino acids used to counteract the impact of deleterious environmental stresses.

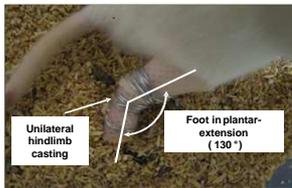
A prevention of muscle loss during the immobilization period followed by a better recovery in then an important public health issue.

It is now well established that exercise is very efficient to prevent muscle mass loss following immobilization (Ferrando et al, 1997). However, exercise is not always relevant in some specific physio-pathological situations such as invalidating diseases or frailty for instance. Nutrition can be a surrogate anabolic strategy capable to preserve muscle mass during immobilization and to speed up the recovery period. The induction of an oxidative stress and a lowered response of protein synthesis to meal has been observed during immobilization. Nevertheless, these deleterious effects on muscle mass could be counteracted by a targeted nutritional strategy.

Aim of the study:

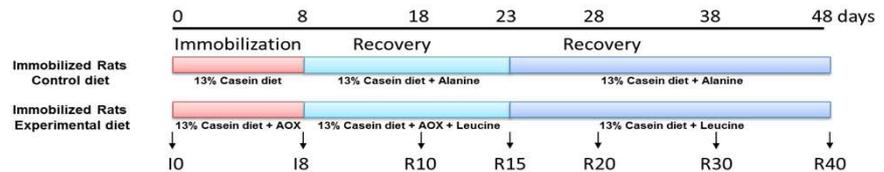
To assess the beneficial effect of a combined nutritional strategy (leucine and antioxidants) to counteract muscle loss and sustain / stimulate muscle protein synthesis during immobilization and subsequent recovery in rats

Protocol and experimental model



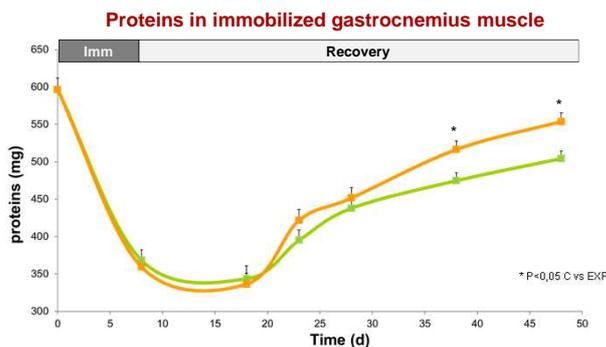
Model of cast immobilization

265 adult rats (6 months) were subjected to unilateral hindlimb immobilization for 8 days (I8) and allowed to recover for 10 to 40 days (R10, R15, R20, R30, R40, n=18 per time). Animals were fed a control diet (C) or the same diet (EXP) supplemented with AOX (hesperitin-7-O-glucoside, vitamin E, green tea catechins, curcumin, rutin) (I0 to I8), AOX+leucine (AOX + LEU) (I8 to R15) and LEU (R15 to R40). Muscle mass and protein synthesis were measured in the post prandial (PP) and the post absorptive (PA) states in immobilized and non-immobilized gastrocnemius muscle. Data were analysed by ANOVA.



Results

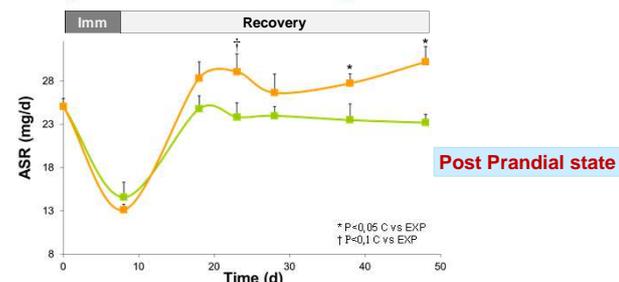
Impact of the nutritional strategy on muscle protein synthesis Consequence on muscle mass



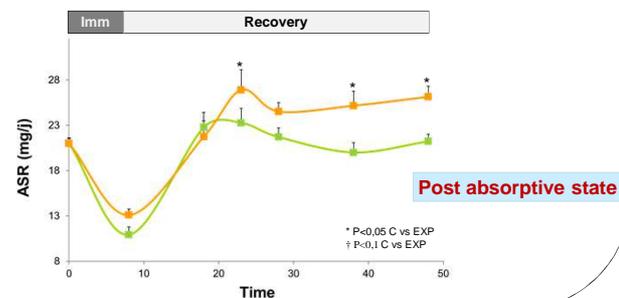
- ✓ The protein muscle mass was significantly ($P<0.05$) decreased by 39% both in the Control (C) and experimental diet (EXP) after the immobilization period (I8) relatively to I0
- ✓ A significant ($P<0.05$) increased muscle protein mass was observed in the EXP group relatively to the C group during the recovery period : ie : 30 and 40 days after the cast removal.
- ✓ Absolute synthesis rate in the EXP group was above the C group during the recovery period (R40: +24% and +30% for EXP vs C in the PA and PP states respectively, $P<0.05$)

Explained by

Absolute protein synthesis rate in immobilized gastrocnemius muscle



Post Prandial state



Post absorptive state

Conclusion

The dietary supplementation in leucine and antioxidants :

- Did not limit the muscle protein mass loss after immobilization
- Accelerated muscle protein mass recovery via a stimulation of both the post prandial and post absorptive muscle protein synthesis (i.e. : throughout the entire day) which improved anabolism and shortened the duration of the recovery period.

Hence, such a nutritional strategy can be a valuable means to promote recovery after disuse for adult patients unable to exercise during recovery.