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Original article

"Fast proteins" with a unique essential amino acid content as an optimal nutrition in the elderly: Growing evidence

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SUMMARY

Background & aims: Adequate protein intake is crucial to maintain body protein content in elderly subjects, but quality of dietary proteins should be also considered since amino acid composition and rate of protein digestion modulate amino acid availability. This study investigates whether the efficacy of optimal protein intake levels for protein retention in the elderly is influenced by protein quality.
Methods: We investigated the effect of a 10-day adequate-protein (AP) or high-protein (HP) diet together with the protein source as caseins (CAS) or soluble milk proteins (PRO) on whole-body (WB) protein synthesis (PS) and protein breakdown (PB) in 4 groups of healthy elderly men (mean ± SEM: 71.8 ± 24.4 yr). The study consisted of two periods of 4 h each: a post-absorptive period and a post-prandial period. The fed state was defined by consumption every 20 min and for 4 h, of either 15 g or 30 g of PRO or CAS. Steady-state WB and splanchnic leucine kinetics were measured using a continuous infusion of L-[1-13C]leucine in the postabsorptive state and L-[1-13C]leucine infusion plus oral L-[5,5,5-2H3]leucine in the postprandial state.
Results: WB PS was stimulated by feeding only with HP diets, whereas WB PB corrected for splanchnic extraction showed a similar pattern of post-feeding decrease in all groups. Consequently, net leucine balance was greater in the postprandial state after HP meals than after AP meals, with PRO meals leading to a better postprandial leucine balance (3.63 ± 0.16 μmol kg FFM^{-1} min^{-1} *vs.* 2.77 ± 0.21 μmol kg FFM^{-1} min^{-1} for PRO HP and CAS HP, respectively; $P = 0.005$).
Conclusion: Postprandial protein retention was better improved in elderly men by an increase in protein intake when the protein supplementation was provided as fast-digesting proteins that induce high leucine availability.

1. Introduction

The elderly population is rapidly expanding worldwide, making innovative strategies to decrease the prevalence of age-related disorders and maintain elderly quality-of-life a major socio-economic and public health challenge. Optimal nutritional intake strategies have been shown to improve health outcomes, but the crucial factor in aging subjects is to get the right dietary strategy to preserve protein homeostasis.[1]

Elderly people tend to consume less than the recommended dietary allowance of protein (RDA = 0.8–1.0 g kg body wt^{-1} d^{-1} depending of the country considered), likely resulting in an accelerated body protein loss[2] and impaired physiological functions. The RDA may be slightly higher for elderly people than for young people, but the impact of different levels of protein intake and intrinsic protein quality in elderly subjects has attracted little attention from the research community.[3]

Dietary proteins need to be considered not only quantitatively but also qualitatively, as their properties could provide a basis for

Non-standard abbreviations: FSR, Fractional Synthesis Rate.

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Table 1
Physical characteristics of the subjects.

	All subjects ($n = 31$)	PRO HP ($n = 8$)	PRO AP ($n = 8$)	CAS HP ($n = 8$)	CAS AP ($n = 7$)
Age (yr)	71.8 ± 2.4	72.8 ± 1.1	71.1 ± 0.8	71.5 ± 0.5	72.0 ± 1.1
Body weight (kg)	73.6 ± 1.2	74.9 ± 2.5	70.4 ± 2.4	73.5 ± 2.3	75.9 ± 2.8
BMI (kg/m^2)	24.9 ± 0.3	24.9 ± 0.9	24.3 ± 0.5	25.1 ± 0.7	25.4 ± 0.6
FFM (kg)	52.0 ± 0.9	51.5 ± 1.2	51.3 ± 1.7	53.9 ± 1.3	51.2 ± 3.4
Fat mass (%)	28.8 ± 1.4	30.9 ± 2.6	26.3 ± 2.1	26.0 ± 3.2	33.0 ± 3.6
Fasting insulin (μUI/ml)	14.4 ± 1.5	11.0 ± 1.8	15.1 ± 2.7	14.9 ± 1.3	16.7 ± 4.9

PRO HP: high protein meal with a soluble milk protein source; PRO AP: adequate protein meal with a soluble milk protein source; CAS HP: high protein meal with a casein source; CAS AP: adequate protein meal with a casein source; FFM: fat-free mass. Values are means ± SEMs. Fat mass and FFM were evaluated from specific equations based on resistance value obtained on a monofrequency (50 kHz) bioelectrical impedance analyzer (16).

innovative strategies to limit body protein loss during aging. The anabolic action of dietary proteins depends on their composition in terms of essential amino acids,[4] notably leucine which is the most potent branched-chained amino acid (BCAA) acting not only as a substrate for protein synthesis but also as a signal to activate translation.[5] The time-course of daily protein administration (spread vs. pulse protein pattern)[6] and digestion rate (slow vs. fast proteins concept)[7] have recently been defined as major regulatory factors of postprandial protein metabolism. Modulating protein feeding pattern may be a more attractive option than simply increasing protein intake when the goal is to improve protein turnover and retention in the elderly. Likewise, the rate of dietary amino acid delivery within the body is an important and independent factor modulating protein retention.[7,8] By feeding "slow" or "fast" protein meals, a previous study demonstrated that protein digestion rate differentially affects anabolic response in young and older adults,[9] as only faster-digesting proteins promote anabolism in elderly subjects.[9] Thus, in addition to quantity and amino acid profile, protein digestion rate should now be considered an independent factor modulating postprandial protein deposition.

However, it is not known whether the effect of protein digestion rate on WB protein metabolism would be different according to adequate or highdietary protein intake in elderly subjects. We thus investigated the effect of a 10 day-adequate-protein (1.0 g kg body wt^{-1} d^{-1}) or high-protein (1.2 g kg body wt^{-1} d^{-1}) diet on WB protein synthesis and breakdown both in the postabsorptive and postprandial states in elderly men. We hypothesized that the efficacy of protein intake on WB protein retention would be influenced by protein quality, with "fast" proteins inducing high leucine availability.

2. Materials and methods

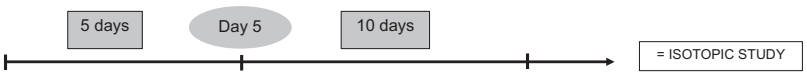
2.1. Subjects

Thirty-one healthy men aged 71.8 ± 2.4 yrs participated in the study. The physical characteristics of the subjects are listed in Table 1. Each subject had a normal blood biochemical profile and physical condition without any medical history of renal, cardiovascular, endocrine, digestive, hepatic, inflammatory or currently-evolving disease. Subjects were excluded from the study if they had undergone any surgery in the 3 months before the study. None of the subjects were under medication liable to affect the parameters under study (i.e. corticosteroids, β-adrenergic blockers and anticoagulants) or modify intestinal protein absorption. Subjects did not consume vegetarian diets and did not take any nutritional supplements (vitamins, minerals, polyols, fibre) the three months before and during the study. All subjects were sedentary (no participation in any regular exercise program) and were asked not to change their level of physical exercise before and during the study.

The study protocol was approved by the Ethical Review Board of the Human Nutrition Research Center at Clermont-Ferrand, France, in accordance with the Declaration of Helsinki. Each volunteer gave his written informed consent after being explained the purposes, methodology and potential risks of the study.

2.2. Experimental protocol

The study was designed as a double-blind, randomized trial in order to compare two different types and amounts of milk proteins (See Experimental design on Fig. 1). The isotopic study was



	Adaptive period	*Experimental period*
High-protein groups: HP • Soluble milk proteins (PRO HP) • Caseins (CAS HP)	1.2 g protein.kg FFM^{-1}.d^{-1} ↳ 10.0% of total energy intake	1.9 g protein.kg FFM^{-1}.d^{-1} ↳ 15.0% of total energy intake
Adequate-Protein groups: AP • Soluble milk proteins (PRO AP) • Caseins (CAS AP)	1.2 g protein.kg FFM^{-1}.d^{-1} ↳ 10.0% of total energy intake	1.5 g protein.kg FFM^{-1}.d^{-1} ↳ 12.5% of total energy intake

Fig. 1. Experimental design. The isotopic study was preceded by two consecutive periods with food intake control: −5-d adaptive period where subjects received a controlled diet providing 1.2 g protein kg FFM^{-1} d^{-1} representing 10.0% of total energy intake. −10-d experimental period where subjects consumed daily a drinkable dairy product containing either soluble milk proteins (PRO) or caseins (CAS). Daily protein intake represented 15.0% of total energy intake (1.9 g protein kg FFM^{-1} d^{-1}) for the HP groups (CAS HP and PRO HP) or 12.5% of total energy intake (1.5 g protein kg FFM^{-1} d^{-1}) for the AP groups (CAS AP and PRO AP). Daily protein intake was expressed with regard to weight of fat-free mass (FFM), evaluated from specific equations based on the resistance value obtained on a monofrequency (50 kHz) bioelectrical impedance analyzer (16).

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