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Post-prandial protein handling: You are what you just ate

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Skeletal muscle is a remarkably dynamic tissue, continuously undergoing a process of renewal. Skeletal muscle proteins are constantly synthesized and broken down, a process referred to as muscle protein turnover. This turnover occurs at a rate of approximately 1–2% per day, allowing muscles to recondition and adapt to varying levels of use. This adaptability, often termed muscle plasticity, is a key feature of skeletal muscle tissue, enabling it to respond to changes in activity or mechanical load. For instance, endurance and resistance-type exercises result in distinct adaptations in muscle structure and function. The phenotypic differences between endurance athletes and bodybuilders illustrate how skeletal muscle can remodel itself based on the type and intensity of exercise that is performed regularly. While this reconditioning is beneficial, skeletal muscle also adapts to reduced levels of physical activity, leading to muscle deconditioning. Muscle deconditioning is observed in various situations, such as during periods of immobilization (e.g., following an injury) or as part of the aging process. Age-related loss of muscle mass, known as sarcopenia, becomes even more pronounced when aging is accompanied by the development of chronic diseases. Conditions such as cancer cachexia, chronic obstructive pulmonary disease (COPD), diabetes, and cardiovascular diseases are often associated with an accelerated loss of muscle mass and function. In essence, muscle maintenance is an active, dynamic process that relies on anabolic stimuli. The two most important anabolic stimuli, that we typically encounter on a daily basis, are nutrition and physical activity. Ingestion of protein in our diet provides us with essential and non-essential amino acids. These amino acids will form the building blocks of newly synthesised muscle proteins. Interestingly, the dietary protein derived amino acids are more than mere building blocks for our muscle protein, as they also act as strong signalling molecules, directly activating anabolic pathways that stimulate muscle protein synthesis. The essential amino acids (EAA), and more particularly the amino acid leucine, play a pivotal role in activating the mTOR (mechanistic target of rapamycin) pathway, leading to an increase in muscle protein synthesis. Of course, the availability of all amino acids, both essential and non-essential, will be required to support the post-prandial increase in muscle protein synthesis. The process of increased muscle protein synthesis following protein ingestion is regulated at multiple levels, beginning with the digestion of protein and the subsequent absorption of the amino acids. During digestion, proteins are broken down into amino acids, which are subsequently absorbed in the gut. The greater part of those amino acids will be released in the circulation. Whether these amino acids will reach the muscle will depend on the hormonal response to the ingested meal. Post-prandial release of insulin will stimulate the perfusion of insulin sensitive tissues, such as skeletal muscle. Protein derived amino acids will be delivered to muscle tissue, where they will activate the signalling pathways involved in muscle protein synthesis. The stimulation of the anabolic signalling cascade combined with an adequate supply of essential as well as non-essential amino acids will then support the post-prandial rise in muscle protein synthesis rates. This coordinated response highlights the critical role of nutrition and metabolic regulation in maintaining and improving skeletal muscle health.

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