OMICS in the study of nutrition: transcriptomics

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Skeletal muscle is a major target organ of adaptation to exercise. Remodelling of skeletal muscle in response to exercise (of any mode) engenders the development of bespoke cellular adaptation. Well recognised features include accretion of contractile proteins (i.e., hypertrophy) and mitochondrial biogenesis (i.e., promoting fatigue resistance). OMICS at the level of the transcriptome, focuses on mRNA species. In exercise sciences transcriptomics has been the subject of intense study over the past ~25 years, first using microarray technology and more recently, RNASeq approaches. The basis of these approaches is to develop better understanding of how exercise, for instance resistance or endurance exercise, lead to distinct adaptations i.e., induce distinct molecular programmes. This has facilitated to the discovery of key genes involved in exercise adaptation, such as e.g., Peroxisome proliferator-activated receptor gamma coactivator 1-alpha (PGC-1α).

Exercise-nutrition interactions are significant for both acute exercise performance but also adaptation to exercise. Protein nutrition is central since dietary protein provides muscle the building blocks for cellular adaptations to exercise. We and others for example, have shown that exercise also is catabolic, whereas proximal intake of dietary protein enhances muscle protein synthesis (MPS) to engender positive net balance and thereby promote remodelling. it follows that dietary protein regimens can support successful long-term adaptations.

While the effects of exercise on the skeletal muscle transcriptome have been the subject of intense study, despite receiving less attention, nutrition itself also affects the muscle transcriptome. For instance, it has been shown that dietary protein, leucine, and its metabolites (e.g., HMB) alone or in combination with exercise modifies the muscle transcriptome - highlighting the importance of this interaction in exercise adaptation. That is, nutrients such as dietary proteins, act more than simply building blocks for MPS. As such, understanding interactions between nutrition, the muscle cell transcriptome, and its coordination with exercise, could lead to strategies to promote exercise adaptation.