University of Naples Federico II

Department of Pharmacy

International PhD course in

Nutraceuticals, Functional Foods and Human Health

PROJECT TITLE: Prevention and Management of Meta-Inflammation-Associated Multiorgan Failure: role of sulfur dietary and water bioactive compounds

Tutor: Prof.ssa Mariarosaria Bucci **Co-tutor: Prof. Giuseppe Cirino**

Project description:

Meta-inflammation is a chronic, low-grade, inflammatory state commonly associated with metabolic disorders such as obesity, type 2 diabetes, and aging (1, 2). It is characterized by persistent activation of immune pathways, increased infiltration of immune cells into metabolic tissues, and elevated circulating levels of pro-inflammatory cytokines such as IL-6, TNF-α, and IL-1β (3,4). This ongoing inflammation disrupts tissue homeostasis, leading to insulin resistance, skeletal muscle atrophy, mitochondrial dysfunction, and progressive multiorgan damage (5, 6). Addressing meta-inflammation is critical to mitigating morbidity and mortality in aging and obese individuals (7). Recent evidence highlights the role of dietary components in modulating inflammation and restoring tissue function. In this context, it has been demonstrated that cruciferous vegetables (e.g., broccoli, kale, cabbage) which are rich in sulfur-containing bioactive compounds (e.g erucin, glucoraphanin, sulforaphane) exert anti-inflammatory, antioxidant, and cytoprotective effects (8-10). Indeed, it has been shown that glucoraphanin improves sarcopenia, (11) while erucin improves obesity-induced skeletal muscle dysfunctions (12) and vascular complications related to metabolic syndrome (13). Similarly, organosulfur compounds derived from garlic (e.g., diallyl disulfide and diallyl trisulfide) are known to modulate redox balance and immune responses through hydrogen sulfide (H_2S) signaling (). Finally, Chinese women consuming high amounts of cruciferous vegetables showed decreased circulating levels of pro-inflammatory cytokines (5). Therefore, this project aims to investigate the preventive and therapeutic potential of natural sulfur compounds in modulating meta-inflammation and preventing multiorgan failure, focusing on the molecular pathways activated by H_2S signaling and their role in restoring tissue homeostasis. The study will combine in vitro and in vivo models of metabolic dysfunction and chronic inflammation to evaluate changes in cytokine profiles, mitochondrial function, muscle integrity, and systemic inflammation markers. This project could contribute to the development of precision nutrition strategies aimed at improving long-term metabolic and organ health in at-risk populations.

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