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Abstract

In Vitro Evaluation of the Effects of Plant-Based Protein Digestates on the Biology and Metabolism of Human Preadipocytes and Adipocytes †

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Abstract: Background and Objectives: Excessive deposits of white adipose tissue lead to obesity. Preadipocyte differentiation, adipocyte metabolism, and some inflammatory and profibrotic factors are key in modulating early fat mass expansion and chronic low-grade inflammation and could be targeted to prevent child obesity. Plant-based proteins are being increasingly used, and we evaluated the potential impact on adipose cell biology and the inflammatory processes of some of them, after simulated in vitro gastrointestinal digestion, on (1) the human preadipocyte differentiation, (2) their fibro-inflammatory state, (3) the metabolism of human mature adipocytes, and (4) the beiging potential of two selected digestates on preadipocytes. Methods: (a) Preadipocytes and (b) mature adipocytes isolated from human subcutaneous adipose tissues were treated with eight plant-based protein digestates (PBPDs) and one animal-based protein digestate for (a) 7 to 11 days or (b) 24 h, respectively. We assessed (a) their effects on preadipocytes, in proadipogenic ± proinflammatory conditions, by evaluating cytotoxicity, cell number, lipid droplet accumulation, adiponectin secretion, and UCP1 expression on the one hand, and IL6, CCL2, and fibronectin secretions on the other hand, and (b) their effects on adipocyte metabolism by studying cytotoxicity, lipolysis activity, and adiponectin secretion. Results: Six PBPDs stimulated adiponectin's secretion by the preadipocytes without affecting their viability and differentiation capacities at the tested doses. Similarly, we observed no cytotoxicity effects on mature adipocytes and a dose-dependent increase in their adiponectin secretion for treatment with five PBPDs. One PBPD modulated the lipolytic activity of adipocytes by decreasing the release of glycerol. In proinflammatory conditions, seven PBPDs reduced the number of preadipocytes, which is abnormally increased with inflammation. Two of them were able to decrease the CCL2 chemokine secretion, and one of them reduced the production of fibronectin, a potential pro-fibrotic protein. Finally, two selected PBPDs were able to increase beige differentiation (UCP1 expression) of preadipocytes cultured in proadipogenic conditions. Discussion: This study revealed potential benefits of plant proteins for obesity prevention, and specifically highlighted the respective properties of pea and oat proteins prototypes: increasing adiponectin secretion and beige differentiation in preadipocytes; decreasing pro-inflammatory and fibrotic molecules secretion by proinflammatory preadipocytes and regulating basal lipolysis and increasing adiponectin secretion by mature adipocytes.

Keywords: plant-based; proteins; preadipocyte; adipocyte; inflammation; beiging; obesity

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