



Role of Adipokines in the Regulation of Metabolic Homeostasis and Energy Balance

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Introduction

Adipose tissue is no longer regarded as a passive fat storage site but is now recognized as an active endocrine organ that plays a critical role in metabolic regulation. It secretes a wide range of bioactive molecules known as adipokines, which influence appetite, insulin sensitivity, inflammation, lipid metabolism, and energy balance. Dysregulation of adipokine secretion is closely linked to obesity, insulin resistance, type 2 diabetes mellitus, and cardiovascular disease. Understanding the role of adipokines in metabolism provides important insights into the mechanisms underlying metabolic disorders [1,2].

Discussion

Adipokines are hormones and cytokines produced primarily by adipocytes, although immune cells within adipose tissue also contribute to their secretion. Key adipokines include leptin, adiponectin, resistin, visfatin, and pro-inflammatory cytokines such as tumor necrosis factor- α and interleukin-6. These molecules exert systemic effects by acting on the brain, liver, muscle, pancreas, and immune system [3,4].

Leptin is one of the most well-studied adipokines and plays a central role in appetite regulation and energy expenditure. It acts on the hypothalamus to suppress hunger and increase energy utilization. In obesity, circulating leptin levels are elevated, but leptin resistance develops, reducing its effectiveness and contributing to excess energy intake and weight gain. Adiponectin, in contrast, enhances insulin sensitivity, promotes fatty acid oxidation, and exhibits anti-inflammatory properties. Unlike other adipokines, adiponectin levels are reduced in obesity and type 2 diabetes, making it a protective factor in metabolic health [5].

Pro-inflammatory adipokines such as tumor necrosis factor- α and interleukin-6 contribute to metabolic dysfunction by impairing insulin signaling pathways. Chronic low-grade inflammation in expanded adipose tissue leads to increased secretion of these

cytokines, which activate stress-related kinases and promote insulin resistance in peripheral tissues. Resistin has also been implicated in glucose intolerance and inflammation, although its role in human metabolism remains less clearly defined.

Adipokines also influence lipid metabolism by regulating lipolysis, fatty acid uptake, and triglyceride storage. Dysregulated adipokine profiles promote ectopic fat accumulation in the liver and muscle, further exacerbating insulin resistance. Additionally, adipokines interact with the immune system, linking metabolic regulation with inflammatory responses.

Conclusion

Adipokines play a pivotal role in coordinating metabolic processes and maintaining energy homeostasis. An imbalance in adipokine secretion contributes to the development of obesity-related metabolic disorders through effects on insulin sensitivity, inflammation, and lipid metabolism. Targeting adipokine pathways offers promising opportunities for therapeutic interventions aimed at improving metabolic health and preventing chronic metabolic diseases.

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