Abstract

Lipids create an essential part of pancreatic β-cells. Not only they are the principal structural components and energy source, but they also play an indispensable role in β-cell physiology. Their metabolism is tightly interconnected with the metabolism of glucose, the fundamental β-cell molecule. The presence of lipids is critical for glucose-stimulated insulin secretion and their turnover is inevitable for correct β-cell function. Lipids in the form of triacylglycerols, retinyl esters and cholesterol esters are stored in lipid droplets. These dynamic cellular structures are important for lipid metabolism and the protection of the cells against various types of stress. However, chronic exposure of β-cells to glucose and lipids can lead to disrupted glycerol/non-esterified fatty acid (GL/NEFA) cycle function, glucolipotoxicity and further dysfunction of β-cells, their dedifferentiation, insulin resistance, and finally type 2 diabetes. The experimental part focused on lipid metabolism in pancreatic β-cells in connection with glucose metabolism and redox environment. Glucose-induced expression of proteins involved in lipid metabolism (fatty acid activation, lipolysis, lipogenesis, etc.) and the effect of modulated redox environment was investigated in β-cell line INS1E and isolated mouse pancreatic islets. The lipid droplet content was dependent on the amount of glucose and reactive oxygen species content and was increased in the presence of oleate and orlistat (lipolysis inhibitor). Glucose and reactive oxygen species production also affected the content of free fatty acids in INS1E cells and the release of glycerol. Based on the experiments, it is evident that in the short term, glucose activates lipid metabolism in pancreatic β-cells, allowing the creation of metabolic coupling factors for insulin secretion and fine-tuning the cellular metabolism to maintain the proper function of β-cells.

Keywords: pancreas, glucose, lipids, redox environment, metabolism