Abstract

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Title of diploma thesis: Effect of simple sugar consumption on cognitive functions in female rats

The consumption of simple sugars, especially fructose, increased in the past few decades. Excessive sugar intake has been associated with the development of insulin resistance, hypertriglyceridemia and oxidative stress which lead to the impairment of cognitive functions. Nevertheless, it is still unclear whether these alterations in cognitive functions are exclusively caused by high caloric intake or if they are related to specific characteristics of fructose. Moreover, the mechanisms involved are not yet fully deciphered at the molecular level.

Our research group supplemented Sprague-Dawley female rats with 10% w/v glucose in drinking water or with isocaloric fructose solution in a long-term study (7 months), simulating the chronic consumption of sugars in humans. Plasma parameters and expression of proteins, involved in metabolic pathways, were determined in the frontal cortex. Cognitive functions were evaluated through the novel object recognition (NOR) and Morris Water Maze (MWM) tests.

Results, obtained in our study, showed a significant increase of fasting and postprandial triglyceridemia (1.9- and 1.4-fold, $p<0.05$) only in the fructose group. Moreover, only fructose-supplemented rats displayed impaired insulin signaling and abnormality in the glucose tolerance test. Insulin degrading enzyme was significantly increased (1.86-fold, $p<0.05$) and protein levels of insulin receptor substrate 2 (IRS2) (0.77-fold, $p<0.05$) and phosphorylated protein kinase B (p-Akt) (0.72-fold, $p<0.05$) were reduced in the frontal cortex. Additionally, fructose-drinking rats showed altered expression of proteins involved in mitochondrial biogenesis and decreased levels of brain-derived neurotrophic factor (BDNF). Results from MWM test did not show any differences among all groups, whereas in NOR test only fructose-supplemented rats

showed a significant reduction in the discrimination index, suggesting impaired memory.

In conclusion, liquid fructose-supplemented rats, but not isocaloric glucose-supplemented rats, showed significant alterations in metabolism, impaired molecular pathways and mitochondrial functions leading to cognitive dysfunction. Therefore, deleterious effects can be attributed to fructose consumption and not exclusively to the high caloric intake.

Key words: cognitive dysfunction, simple sugars, frontal cortex, metabolic impairment