Persistence or reversibility of fructose induced brain alterations after switching to healthy diet

Abstract: In previous decades, a significant increase in the fructose content of the human diet has occurred, far above what is introduced daily with fruits and vegetables, because of the increased consumption of industrial foods and the extensive commercial use of high-fructose corn syrup (HFCS) as a sweetener for beverages, coffee, snacks, and bakery foods. High fructose consumption has long been known to expose the consumer to health risks, such as obesity, lipid alterations, insulin resistance, and inflammation. Metabolic risk factors related to poor nutrition can arise at a very early age; investigations are required to clarify the brain consequences resulting from a diet rich in fructose at a critical stage of development. Indeed, despite the importance of this issue, few studies have been performed in rodents, providing evidence that, in childhood and adolescence, critical periods of neurocognitive development, the impact of high dietary fructose consumption on hippocampal and cortex function is particularly damaging.

Introduction: The young age is often characterized by a high consumption of processed foods and fruit juices rich in fructose. These habits are critically involved in obesity induction, and also promote alterations in brain function that could persist even with the return to a healthy diet.

Methods: Young rats (30 days old) were fed a high fructose or control diet for 3 weeks. At the end of treatment half of fructose-fed rats were fed a control diet for further 3 weeks to investigate the possible persistence of the brain changes. Glucose transporter-5 (Glut-5), fructose and uric acid levels, oxidative status, inflammation, as well as survival markers of synaptic function were investigated by Western blotting and spectrophotometric or enzyme-linked immunosorbent assays, in the hippocampus and prefrontal cortex, areas of the brain critically involved in learning and memory.

PREFRONTAL CORTEX

Glut-5 Expression, Fructose and Uric Acid Level

Markers of Inflammation

Markers of Oxidative Status

Analysis of Syaptic Proteins

Conclusions: The picture that emerges from this study, conducted on a young rodent model, confirms that fructose can have a strong impact on brain function at a young age by promoting inflammation of the hippocampus and prefrontal cortex, oxidative stress and alteration in post-synaptic proteins. These changes could undoubtedly have an important impact on neuronal activity and, in general, on cognitive function, especially at a young age, a very critical phase of brain development. Most of the alterations induced by a high fructose diet can be saved by returning to a control diet. A notable exception is represented by the levels of N-Tyr, a marker of oxidative stress, which remain higher as an imprint of the previous damage in hippocampus. The investigation of the real consequences of persistent alterations in these markers certainly deserves further attention and may represent a problem for further studies. It cannot be ruled out that a longer period of fructose intake may favor brain alterations to a greater extent that are difficult to reverse with the return to a healthy diet.