Impact of transcranial electric stimulation on molecular and elemental components in the brains of rats addicted to high-caloric nutrients – the study by infrared and synchrotron X-ray imaging spectroscopies

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A high-caloric diet is now considered as one of the most significant risk factors for developing serious lifestyle cardiovascular and neurological diseases. It is surmised that overnutrition may overbalance the electric activity in the brain areas triggering appetite and craving, gradually leading to food addiction and finally obesity [1]. In order to understand the impact of the high-caloric diet on brain activity, the interplay between changes in molecular components and metal ions must be studied in the brain areas particularly affected by food addiction [2]. In our study, we aimed at showing, whether or not, impacting the brain electric activity by transcranial direct current brain stimulation (tDCS) has any behavioral and biochemical effects on lipid, protein secondary structure and levels of metal ions [3]. For doing so, thin brain tissue sections were taken from electrically- and sham-stimulated rats on a high-caloric diet. The samples were raster-scanned with current state-of-the-art modern molecular and elemental micro-imaging modalities: Fourier transform infrared and vacuum-based synchrotron X-ray fluorescence (ELETTRA synchrotron facility in Trieste, Italy) spectroscopies. The contribution will aim at outlining the details of our unique brain stimulation procedure, and comparing the most striking molecular and elemental changes invoked in the appetite-triggering brain areas of obese rats. It will be demonstrated that the clinical efficacy of anodal-type tDCS has a stronger impact on the brain by altering the surface masses of the metal ions such as Na⁺, K⁺, and Cl⁻. Perturbation in major molecular components will be shown to correlate with metal ions. The study, although preliminary, demonstrates that by stimulating the brains of rats addicted to high-caloric diet, the feeding behavior can be significantly changed, resulting in decreased appetite and craving. Therefore, our brain stimulation method paves the way for the novel treatments for challenging the most common metabolic syndromes causing overnutrition and obesity.

Keywords: brain stimulation, obesity, Fourier transform infrared spectroscopy, synchrotron X-ray fluorescence

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References