Differential Effects of Food Additives on Catalase and Its Close Interactors: An Innovative Approach to Analyze the Effects of Food Additives on the Reactive Oxidative System that Impact Health

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A byproduct of many cellular metabolic reactions is reactive oxygen species (ROS). An increase in ROS levels or a decrease in the cellular antioxidant capacity causes oxidative stress and is implicated as a primary mechanism in human diseases such as diabetes and cancer. The central hypothesis of this project was that the health effects of various food additives are determined by distinct changes in the antioxidant enzyme system. Cell culture studies in human normal and breast cancer cell lines indicated short-term effects of ginger, monosodium glutamate (MSG), and NaCl (table salt) on catalase activity. Ginger had a transient effect whereas the MSG effect was sustained for a longer time period. Salt reduced the activity in all cell types. The novel aspect of this study is the bioinformatic analyses of publically available microarray data from studies with in vivo long term usage of different food additives. The mRNA expressions of catalase and its close gene interactors that regulate the ROS were studied. The analyses reveal that the effects of food additives on gene-expression are tissue and gender-specific. Long term garlic intake increased the expression of most ROS regulators in the spleen. MSG and trans-fatty acid showed varied effects on cardiac tissue depending on gender types. High fructose corn syrup diet lowered the expression of ROS enzymes in liver and adipose tissues. In summary, long term use of common food additives affect the body's antioxidant system by altering the expression of a cadre of genes involved in maintaining the homeostasis of this system. Oxidative stress is directly been linked to many diseases. This study helps to understand the pleotropic effects of food additives on body's ROS system and its implications for health.