Title Protective effect of sage against oxidative stress-induced death of brain astrocytes

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Abstract

It is well established that cells in the central nervous system (CNS) are highly susceptible to oxidative damage due to a high consumption of oxygen. Oxidative stress induced by excess production of reactive oxygen species (ROS) has been implicated in pathologic processes associated with brain injuries and various neurodegenerative diseases including ischemia, Alzheimer's disease, Parkinson's disease, Huntington's disease and schizophrenia. H_2O_2, a major form of ROS, has been shown to mediate cell damage either through direct oxidation of lipids, proteins and DNA or it can act as a signaling molecule to trigger intracellular pathways leading to cell death. Astrocytes, the most abundant glial cell type in the brain, not only protect neurons from ROS, but also contribute to maintaining the homeostasis of the neuronal environment. Thus any damage to them will affect neuronal survival. In this study, we used a model system in which cultured primary astrocytes were exposed for 24 hr to H_2O_2-induced oxidative stress and cell viability was then assessed. Using this experimental system we have compared the effect of 25 essential oils prepared from different herbs and spices for their ability to minimizing the cytotoxic damage induced by oxidative stress and to protect brain astrocytes from H_2O_2-induced astrocytic death. Our results show that only one essential oil - the essential oil of sage - has shown such protective activity. This protection was dose dependent and the optimal concentration was 30-40 μg/ml. Maximal protection was obtained by preincubation of astrocytes with the oil of sage for 2 hr before the addition of H_2O_2. In order to find the active constituent/s in the essential oil of sage, we have pretreated the cells with different concentrations of eight of its main constituents and then exposed the cells to H_2O_2. While 1,8-cineole, camphor,α-thujone,β-trans-caryophyllene and β-pinene did not protect from the oxidative stress-induced cell death, the protective effect of sage could be attributed to the presence of α-humulene, α-pinene and camphene. We could also show that two of the constituents of sage -α-humulene and β-trans-caryophyllene are both penetrating the cells and adhere to the cell membranes. It is possible that sage, by attenuating H_2O_2-induced cell death, might be a functional food or may offer means of therapy in the treatment of oxidative stress-induced neurodegenerative disorders.