

Changes in the Rate of Conversion of Calcium Independent Activity to Calcium Dependent Activity of Calcium/Calmodulin Dependent Protein Kinase II (CaMKII) in Rat Cortical Neurons

Abstract:

In the central nervous system, changes in synaptic strength are thought to provide the basis for such fundamental neurological processes, as learning and memory. Cytoplasmic calcium signals play an essential role in regulating synaptic strength, often exerting effects through Calcium/Calmodulin Dependent Protein Kinase II (CaMKII). An unusual feature of this enzyme is that in the presence of calcium it phosphorylates itself and this autophosphorylation converts its activity from a calcium-dependent form to a calcium-independent (autonomous) form. This property has been proposed to allow CaMKII to function as a memory molecule, whose activity can persist after the signal has been terminated. My experiments this summer were designed to investigate the ability of calcium oscillations to convert CaMKII activity to its autonomous form. For these studies I used rat cortical neurons cultured so that they formed a synaptic network that could undergo synchronized calcium oscillation. Measurements of total and calcium-independent activity showed, as predicted, that calcium oscillations increase the calcium-independent activity. Furthermore, addition of Okadaic Acid caused a further substantial increase in calcium-independent activity. This indicates protein phosphatase 1 or 2A is responsible for dephosphorylating CaMKII and thus converting its activity from calcium-independent to calcium-dependent form.