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Protonophoric action of triclosan causes calcium efflux from mitochondria, plasma membrane depolarization and bursts of miniature end-plate potentials

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Abstract

The formerly widely used broad-spectrum biocide triclosan (TCS) has now become a subject of special concern due to its accumulation in the environment and emerging diverse toxicity. Despite the common opinion that TCS is an uncoupler of oxidative phosphorylation in mitochondria, there have been so far no studies of protonophoric activity of this biocide on artificial bilayer lipid membranes (BLM). Yet only few works have indicated the relationship between TCS impacts on mitochondria and nerve cell functioning. Here, we for the first time report data on a high protonophoric activity of TCS on planar BLM. TCS proved to be a more effective protonophore on planar BLM, than classical uncouplers. Correlation between a strong depolarizing effect of TCS on bacterial membranes and its bactericidal action on *Bacillus subtilis* might imply substantial contribution of TCS protonophoric activity to its antimicrobial efficacy. Protonophoric activity of TCS, monitored by proton-dependent mitochondrial swelling, resulted in Ca^{2+} efflux from mitochondria. A comparison of TCS effects on molluscan neurons with those of conventional mitochondrial uncouplers allowed us to ascribe the TCS-induced neuronal depolarization and suppression of excitability to the consequences of mitochondrial deenergization. Also similar to the action of common uncouplers, TCS caused a pronounced increase in frequency of miniature end-plate potentials at neuromuscular junctions. Thus, mitochondrial uncoupling could alter neuronal function through distortion of Ca^{2+} homeostasis.

Key words: protonophore, planar lipid bilayer, mitochondrial uncoupler, antibacterial agent, neuron excitability, action potential, miniature endplate potentials.