Modeling the citric acid cycle, electron transport chain, malate-aspartate and citrate-pyruvate shuttles

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A dynamical model is proposed for describing the key quantities of mitochondrial metabolism. Mitochondria are very important cell organelles, because they take part in the bioenergetic functions of the cells, control metabolic pathways, participate in heat production, in upholding the equilibrium of reactive oxygen species, in Ca^{2+} metabolism, and in the control of apoptotic procedures of the cells. In this work the citric acid cycle, electron transport chain, and two transport systems are modeled, namely the malate-aspartate and the citrate-pyruvate shuttle. The overall model containing three modules is given in the form of kinetic ordinary differential equations with 45 state variables. Simulation results are presented and discussed from a biological point of view.

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