**Abstract**

The key importance of mitochondrial physiology for human health is increasing realized, along with the rapid expansion of the mitochondrial knowledge base. Research efficiency as well as comparative and translational reliability would enormously benefit from a harmonized nomenclature of mitochondrial respiration states and rates. therefore, we set out to develop a recommendation on respiratory states and rates. This is done the framework of the EU-COST MitoEAGLE project and the result is presented here. IUPAC guidelines on general terms of physical chemistry are followed, extended with consideration on open systems and irreversible thermodynamics. We align the nomenclature and symbols of classical bioenergetics with a concept-driven constructive terminology to express the meaning of each quantity clearly and consistently. We define respiratory states. We provide a balanced view on mitochondrial respiratory control and critically discuss coupling and mitochondrial respiration in terms of metabolic rates, fluxes, regulation and control. We provide suggestions for appropriate normalization. Our proposal will contribute to uniform standards for respiratory states and rates and, consequently contribute the development of reference values and databases of mitochondrial function in species, tissues and cells.