Abstract:

Gas exchange is governed by the combined action of oxygen consumption and carbon dioxide production, and the transport of these gasses by diffusion. The diffusion component is formally neglected and implicitly incorporated in respiration and fermentation parameters of the current Michealis-Menten-based respiration models. The aim was to extend existing modelling approaches by including a diffusion controlled component to quantify the permeance of O2 and CO2. Permeances were estimated using a new gas exchange model which assumes that diffusion can be described by Fick's first Law. Fick's first Law can be applied when only one barrier is present. This was shown to be the case for O2 by O2-electrode measurements. The model estimated the permeance per batch on the basis of external gas exchange measurements, internal and external gas conditions, weight and surface per pear. Traditionally, permeances are not estimated, but calculated directly by the Neon method, using Graham's Law. Permeances estimated using the new model were lower for O2 and CO2 than those found with the Neon method. The lower permeances may be explained by the assumption that the Neon method only assesses the permeance of the skin, while the O2 and CO2 permeances established by using the new model represent all barriers between mitochondria and the external atmosphere. The smaller CO2 permeance found using the new model might be explained by the relatively high pH of the cytosol.