

Metabolic Rates

Metabolic rates are estimated using a 4-chamber, indirect open circuit calorimeter system. Each calorimeter chamber (dimensions: 20 cm x 10 cm x 12 cm) receives an airflow rate of 620 ml/min and gas samples are collected at the inlet and outlet ports of each chamber. Oxygen is measured by electrochemical detection using a metal air battery O₂ sensor. O₂ is reduced to hydroxyl ions at the air cathode, which in turn oxidizes the metal anode. The resulting current is proportional to the O₂ concentration. Carbon dioxide is measured by a sensor of the spectrophotometric type, measuring absorption spectra characteristic of carbon dioxide. The energy absorbed is proportional to the carbon dioxide concentration in the sample.

To minimize variability attributable to feeding-induced thermogenesis, animals are food deprived for 2 hr prior to placement in the calorimeter chambers. Animals are monitored for a 5 hr period during the light cycle without food or water. Samples are collected at 15 min intervals throughout the monitoring session. Estimates of whole session oxygen consumption are made by averaging VO₂ measurements across the full 5 hr testing period, and resting VO₂ measurements are indicated by minimum values observed during periods of inactivity. Measurements of VO₂ and VCO₂ are used for the derivation of respiratory quotients ($RQ = VCO_2/VO_2$). The RQ, which typically varies between 0.7 and 1.0, provides an estimate of the energy substrate being utilized. An RQ value of 0.7 indicates the preferential utilization of fat as a substrate of oxidation, while an RQ near 1.0 indicates the predominant oxidation of carbohydrates.