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Oxygen limitation of thermal tolerance defined by cardiac and ventilatory performance in spider crab, *Maja squinado*

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Abstract:

Geographic distribution limits of ectothermal animals appear to be correlated with thermal tolerance thresholds previously identified from the onset of anaerobic metabolism. Transition to these critical temperatures was investigated in the spider crab (*Maja squinado*) with the goal of identifying the physiological processes limiting thermal tolerance. Heart and ventilation rates as well as P_{O2} in the hemolymph were recorded on-line during progressive temperature change between 12 and 0°C (1°C/h) and between 12 and 40°C (2°C/h). Lactate and succinate were measured in tissues and hemolymph after intermediate or final temperatures were reached. High levels of hemolymph oxygenation suggest that an optimum range of aerobic performance exists between 8 and 17°C. Thermal limitation may already set in at the transition from optimum to pejus (pejus 5 turning worse, progressively deleterious) range, characterized by the onset of a decrease in arterial P_{O2} due to reduced ventilatory and cardiac performance. Hemolymph P_{O2} values fell progressively toward both low and high temperature extremes until critical temperatures were reached at ;1 and 30°C, as indicated by low P_{O2} and the onset of anaerobic energy production by mitochondria. In conclusion, the limited capacity of ventilation and circulation at extreme temperatures causes insufficient O₂ supply, thereby limiting aerobic scope and, finally, thermal tolerance.

Key-words: Aerobic capacity, anaerobic metabolism, otpodes, partial pressure of oxygen