

EFFICIENCY OF THERMOREGULATION IN PRECOICIAL AVIAN SPECIES IN THE PRENATAL PERIOD

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Precocial birds are able to increase thermoregulatory heat production (HP) immediately after hatching with decreasing ambient temperature (T_a). Information on HP during embryonic development in birds are contradictory, extending from a transient metabolic response to cooling with a Q_{10} of HP between 1.0 and 2.0 to a typical poikilothermic reaction in altricial bird embryos. Because of these differences standardised experiments for two precocial avian species (Muscovy duck, *Cairina moschata*; Domestic fowl, *Gallus gallus*) were carried out to search for evidence of endothermic reactions. The eggs were incubated at 37.5°C and at a relative air humidity of 70%. After 60 min the influence of lower (31.5°C, 34.5°C or higher (40.3°C) T_a on HP (oxygen consumption) and body core temperature (T_{af}) were estimated for a duration of 3 h. From the relationships between T_{af} and HP the Q_{10} of HP was calculated. The results of experiments show that (1) with decreasing T_{af} the HP dropped generally. In some cases, the parabola-like function describing these relationships showed extreme values situated 1 to 2.0°C lower than the maximum T_{af} . (2) The calculated Q_{10} crossed the 2.0 threshold mostly between 34 and 36°C T_{af} . In some cases no crossing was observed; mostly in older embryos or when the T_a was depressed quickly. (3) Generally, the efficiency of the endothermic reactions during the embryonic development was very low. During the last day of incubation, in the Muscovy duck as well as in the chicken after a 3-h-cold load with decreasing T_a the T_{af} dropped in a linear fashion with a regression coefficient about 1.10 in both species. (4) HP increases in embryos of both species during heat load was either less than calculated by the van't Hoff rule or HP dropped. Summarising, the results show that embryos of precocial birds are endothermic in the last third of incubation. The measured HP of endothermic animals at temperatures below the thermoneutral temperature is the result of two different processes: the thermoregulatory HP and the energy metabolism following the van't Hoff rule. In avian embryos a drop of T_{af} , mostly causes a decrease of net HP, but the decrease is more moderate than predicted by the van't Hoff rule. A Q_{10} of more than 2.0 demonstrates the absence of endothermy. A Q_{10} lower than 2.0 shows that an endothermic reaction occurs. When the Q_{10} is lower than 1.0 the increase of HP due to the thermoregulatory mechanisms is higher than the decrease of HP due to the van't Hoff rule and a net increase of HP occurs with decreasing core temperature. The goal of prenatal endothermy has to be different from that dealing with proximate support of thermoregulation. It is postulated that endothermic reactions during the prenatal period have ultimate influences rather than proximate influences on the efficiency of thermoregulation.

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