THE ROLE OF POSTPRANDIAL HEAT PRODUCTION AND EXERCISE IN ADJUSTING SHIVERING THERMOGENESIS IN JAPANESE QUAIL CHICKS, *COTURNIX COTURNIX JAPONICA*

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Regulatory thermogenesis of birds is composed of shivering thermogenesis, and in cold-acclimated chicks possibly also of nonshivering thermogenesis. Obligatory thermogenesis by postprandial heat production and exercise are regarded as potential substitutes for shivering in cold. These thermal by-products of feeding and locomotion may be of benefit in energy sparing especially in juvenile birds if the energetic costs of regulatory and obligatory thermogenesis are not additive. In this study, the effects of postprandial heat production and exercise on shivering were examined first time at effector (muscle) level in young birds. In a first set of experiments, 8-day-old chicks were exposed to fasting for 31 h. Thereafter, oxygen consumption and shivering EMGs from pectoral and gastrocnemius muscles were measured at ambient temperatures between 33-12°C. At a thermoneutral temperature (33°C), heat production in fasted chicks was 39% lower than in ad libitum fed controls. The absolute difference between control and fasted chicks decreased with decreasing ambient temperature being at 12°C less than half of that observed at 33°C. Despite the lower metabolic rate, the amplitudes of shivering were higher in fasted chicks, especially in pectoralis. This indicates that fasted chicks used shivering to compensate the decrease in postprandial heat production. In the second set of experiments, the effect of exercise on thermoregulation of three-week-old chicks was studied at three different ambient temperatures (25, 15, and 0°C) during forced walking on a treadmill (speed 0.09 $m \cdot s^{-1}$) and at rest. The shivering in pectoralis was suppressed within 20 s after the onset of exercise, at 25°C completely and at 15° and 0°C with a decrease of 20µV. In response to decreasing core temperature, chicks were capable of increasing shivering when walking. The physical strain of exercise, measured as oxygen consumption, was dependent on ambient temperature. Between 15°C and 0°C, a major increase occurred from 72.3 to 143.7 $ml \cdot min^{-1} \cdot kg^{-1}$. Due to shivering suppression and increased forced convection during exercise, hypothermia developed the faster the colder the ambient temperature was. Although exercise interacts with regulatory thermogenesis partially substituting it, the benefit of exercise, if any, is restricted to temperatures slightly below thermoneutrality. Japanese quails chicks are capable of replacing shivering in cold by postprandial heat production but exercise cannot be utilized in thermoregulation either in energetically or thermally favourable way.

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