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Effects of temperature variations during incubation and postnatal growth on performance, metabolism and health of meat-type chickens

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and of the
Fundamental Physiology and Perinatal Development Group (WPSA
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ABSTRACTS

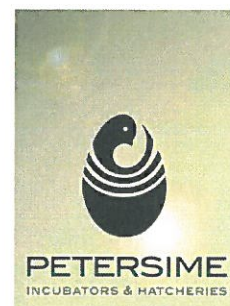
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In the context of climate change where farmers have to face the consequences of increasing frequency of extreme thermal events in Northern countries, and of chronic heat in Southern countries, the adaptive capacities of fast-growing chickens are strongly challenged and become a critical issue. One strategy for improving broiler robustness while potentially limiting energy use is the conception of new incubation strategies exposing eggs directly in incubators to environmental fluctuations. This could prepare the developing bird to sustain later thermal fluctuations on farm. However, the consequences of the combination of both heat and cold embryo stimulations on animal physiology, health status and performance remain to be determined in thermally fluctuating or standard rearing conditions. A multidisciplinary approach was applied to evaluate the effects on selected pathophysiological markers of standard conditions or temperature variations during incubation combined with standard rearing conditions or cool chick start followed by late heat exposure. Incubation condition I_1 including elevated incubation temperatures during mid-incubation and cold stimulations at the end of embryogenesis did not affect hatchability as compared to standard incubation conditions I_0 . Hatched-chick BW were not different between incubation groups. Postnatal chicken BW was affected by both incubation conditions and postnatal conditions, with lower BW in I_1 group than in I_0 , and lower BW in the postnatal variable conditions than in standard conditions. Feed conversion ratio (FCR) was lower in the I_1 treated chickens reared in standard conditions compared to both incubation groups reared in variable postnatal conditions ($P = 0.006$). Chickens exposed to variable conditions were less affected by diarrhea than those in standard conditions at 11 d of age. Mortality was greater in I_1 chicks than in I_0 before 11 d of age ($P = 0.049$), whereas at 35 d, there was no effect of incubation or postnatal conditions on mortality rates. At 41 d, overall mortality and morbidity rates were higher in standard conditions than in variable conditions ($P = 0.046$). Meat quality was affected by both incubation and postnatal conditions: incubation I_1 induced lower values of meat ultimate pH (pHu) measured 24 h after slaughter, but increased drip loss and meat shear force compared to I_0 incubation. Postnatal thermal variations decreased the occurrence of the meat defects white striping and wooden breast, breast yield, drip and cooking loss and yellow color of the meat, but increased abdominal fat percentage, thigh yield, pHu and curing-cooking yield of breast meat. Both factors interacted to affect the lightness of breast meat and its intramuscular lipid content that were lower in I_1 than in I_0 chickens when reared in standard conditions. Only postnatal conditions significantly affected blood gas and ion concentrations. Exposure to postnatal variable conditions increased plasma uric acid concentrations as well as blood total antioxidant status, but decreased the 'reduced to oxidized' glutathione ratio, suggesting a disrupted redox equilibrium in these conditions as compared to control postnatal conditions.

In conclusion, postnatal variable thermal conditions and, to a lesser extent, variable incubation conditions, affected health, performance and meat quality criteria in broiler chickens. The adaptive capacities and metabolism of fast-growing chickens were strongly challenged by postnatal temperature fluctuations, which was not mitigated by incubation conditions including heat and cold stimulations. However, postnatal varying environment limiting growth reduced mortality and meat quality defects as compared to standard conditions at six weeks of age.