

Physiological monitoring of laying hens during whole-house killing with carbon-dioxide gas

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The ongoing threat posed by virulent avian influenza necessitates the availability of rapid, practical, cost-effective and humane methods of emergency killing for poultry. Whole-house carbon dioxide (CO₂) administration has been utilised for this purpose, but there are no detailed studies of its welfare implications. We measured the physiological responses of ten hens equipped with sensors to measure body temperature, respiration, cardiac and brain activity (electroencephalogram, EEG) placed in a commercial poultry house undergoing application of CO₂. Purpose-built telemetric logging units worn by each bird were used to record simultaneously these signals before, during and after gas exposure. Infrared video and thermography, air temperature and gas concentrations were recorded. Liquid CO₂ was injected into a deep pit, tiered cage, commercial poultry house via the pit and a gaseous concentration of 45% CO₂ was achieved within 19 minutes. Gas dispersal throughout the building was not uniform, with injection pressure initially increasing CO₂ concentration away from the injection site. Respiratory, cardiac and EEG responses and localised temperature in instrumented birds were related to position and hence CO₂ concentration. Although sub-zero temperatures were recorded in the immediate vicinity of a few birds, head, body and cloacal temperature measurements indicated no significant hypothermia. EEG characteristics were used to determine an unequivocal time to loss of consciousness. This ranged from 6.0 to 10.5 (average 7.8) min after onset of gas injection and was associated with CO₂ concentrations of approximately 20%. Birds did not experience the gas immediately so the period in which they were potentially conscious and exposed to increasing CO₂ was actually 3.9 to 7.9 (average 5.2) min. Distinctive cardiac and respiratory responses to CO₂ were seen, which were most marked in the conscious phase. In particular, birds responded to inhalation of CO₂ by deep breathing. Time to death varied between 13.7 and 22.1 min after gas injection and related to longitudinal position in the house relative to gas injection. Whole-house killing of hens using CO₂ is reliable and practical, and while birds exhibit prolonged reflex respiratory responses, they do not experience high concentrations of CO₂ while conscious and there is no evidence that they die of hypothermia.

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