

## ANIMAL WELFARE

**Title:** Evaluation and Application of Humane Hypoxia Euthanasia for Nursery Pigs – NPB #09-180

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### Scientific Abstract

Fifty-eight nursery pigs ( $5.6 \pm 1.3$  kg) were utilized to compare physiological, behavioral and neurophysiological parameters of hypobaric hypoxia (HH) and carbon dioxide (CO<sub>2</sub>) euthanasia. This experiment was conducted as a completely randomized design using a 2x2 factorial arrangement of treatments. Factors included euthanasia method: A) hypobaric hypoxia (approximate ascension of 36.9 m/sec) or B) CO<sub>2</sub> gas (induction of approximately 20% of the chamber volume/minute) and 2) health status: A) healthy or B) moribund. Health classification was determined by a veterinarian. Two pigs at a time were euthanized using a 1 m<sup>3</sup> chamber for each method by health status treatment (n=8, CO<sub>2</sub>-moribund; n=8, CO<sub>2</sub>-healthy; n=8, HH-moribund; n=5, HH-healthy). Jugular blood samples were obtained from each pig 24 hours prior to euthanasia. Animals were fitted with ECG and EEG monitoring devices, placed in the chamber and kept in the chamber until death was confirmed via ECG and EEG. In addition to ECG and EEG measurements, behavioral parameters were measured and necropsies were performed. Post-euthanasia, a blood sample was obtained from each pig. The average treatment times were HH,  $27.4 \pm 6.7$  minutes and CO<sub>2</sub>,  $13.8 \pm 5.1$  minutes. EEG data showed that pigs euthanized via CO<sub>2</sub> reached the point of a complete isoelectric state faster than pigs euthanized via HH ( $P = 0.009$ ; HH:  $13.4 \pm 5.6$  min; CO<sub>2</sub>:  $7.8 \pm 8.7$ ). When evaluating the average power of EEG waves in pigs euthanized via hypobaric hypoxia, there was no significant interaction between health status and time ( $P = 0.84$ ). Conversely, there was a significant ( $P = 0.005$ ) time by health status interaction in the evaluation of dominant frequency of EEG waves. At approximately 10,600 m, healthy pigs exhibited higher dominant frequency values than moribund pigs ( $P = 0.0002$ ). When evaluating the average power of EEG waves in pigs euthanized via CO<sub>2</sub>, there was a significant time effect ( $P < 0.0001$ ). As time progressed, the average power of EEG waves decreased. Similar to dominant frequency values in HH pigs, there was a significant ( $P = 0.0007$ ) time and health method interaction. Healthy pigs exhibited higher ( $P < 0.0001$ ) dominant frequency values than moribund pigs after 9-10 minutes of CO<sub>2</sub> induction. Pulmonary lesions were present in 20.7% of hypobaric hypoxia euthanized pigs and only 1.7% of pigs via CO<sub>2</sub> euthanasia ( $P < 0.0001$ ). There was no significant difference in occurrence of lesions between healthy and moribund pigs post euthanasia. Moribund pigs euthanized via CO<sub>2</sub> tended ( $P = 0.08$ ) to have less bouts of paddling than moribund pigs euthanized via HH.

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Additionally, healthy pigs euthanized via CO<sub>2</sub> tended ( $P = 0.09$ ) to exhibit more paddling bouts than moribund pigs euthanized via CO<sub>2</sub>. Pigs euthanized via CO<sub>2</sub> gasped more ( $P = 0.01$ ) in the 25 minute period than pigs euthanized via hypobaric hypoxia. Pigs euthanized via HH fell down more than pigs euthanized via CO<sub>2</sub> ( $P = 0.01$ ). Blood samples were analyzed for lactate ([LAC]), glucose, ionized calcium (iCa), potassium, hemoglobin, and sodium concentrations, percent hematocrit, pH and partial pressures of oxygen ( $pO_2$ ) and CO<sub>2</sub> ( $pCO_2$ ). A health status effect was observed for hematocrit, hemoglobin, iCa, [LAC] and sodium ( $P \leq 0.004$ ). Moribund pigs had higher ( $P \leq 0.05$ ) hemoglobin and sodium concentrations, and percent hematocrit than healthy pigs. Results indicated a significant ( $P \leq 0.03$ ) interaction between sample time (pre-euthanasia vs. post-euthanasia) and treatment (HH vs. CO<sub>2</sub>) for [LAC], glucose, hematocrit, hemoglobin, iCa, potassium, sodium and  $pCO_2$ . Post-euthanasia glucose concentrations were higher ( $P < 0.0001$ ) in pigs euthanized via CO<sub>2</sub> compared to HH. However, post-euthanasia percent hematocrit, hemoglobin concentration, [LAC] and pH were higher ( $P = 0.03$ ) in HH compared to CO<sub>2</sub> euthanized pigs. There were no significant differences for epinephrine or norepinephrine between euthanasia method ( $P = 0.21$ ) or health status ( $P = 0.62$ ) of piglets. Results for cortisol indicated a sample by health interaction ( $P = 0.04$ ). Moribund pigs exhibited higher post-euthanasia cortisol values than healthy pigs ( $P = 0.001$ ). Higher percentage hematocrit and concentrations of hemoglobin are associated with exposure to high altitudes. Higher glucose and [LAC] concentrations may be attributed to differences in length of time the animals remained in the chamber thus altering concentrations of post-mortem metabolites. Further research utilizing hypobaric hypoxia at different altitudes and CO<sub>2</sub> at different induction rates may provide a more concrete solution to determining a low stress, humane method of on-farm euthanasia.