Controlled atmosphere stunning of pigs using nitrogen, argon and carbon dioxide in high-expansion foam

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Background

- Pigs are known to show distress and escape behaviors during commercial CO_2 stunning (Llonch et al., 2012)
- Inert gases has been suggested as a more humane alternative than CO_2
- Studies on the behavioral response of pigs stunned with inert gases (nitrogen (N_2) and argon (Ar)) have shown less aversion than CO_2 (Llonch et al., 2012)
- Studies in pigs suggest that loss of posture (physical collapse) is the earliest behavioral sign of the onset of unconsciousness (EFSA, 2013; Raj, 1999)
- However, several studies have shown loss of posture and convulsions to start before EEG-based loss of consciousness when stunning with CO_2 (Rodriguez et al., 2008; Verhoeven et al.,2016)

Llonch et al. (2012) Animal 6(4): 668-675; EFSA (2013) EFSA Journal, 11(12):3486; Raj (1999) Vet Rec, 144, 165-168; Rodriguez et al. (2008) Anim Welf 17: 341-249; Verhoeven et al. (2016) Front Vet Sci, 3:38.

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Pevious study on N_2 foam

- Proof of concept for the use of N_2-filled foam for stunning of pigs.
- The pigs showed some aversive responses when exposed to foam, e.g. escape attempts.
- No aversive behaviours could be related specifically to N_2 gas (e.g. no gasping was observed).
- Loss of posture occurred 58 s after foam production started.
- Five minutes after nitrogen foam production started, the pigs were assessed to be in deep unconsciousness or dead.

Lindahl et al. (2020) Responses of Pigs to Stunning with Nitrogen Filled High-Expansion Foam, Animals 10(12):2210

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Aim of project

To evaluate an innovative stun method from an animal welfare point of view by comparing behavioural responses and the stun process of pigs exposed to high concentration CO_2, N_2 and Ar in foam.

The overall aim is to improve welfare of pigs at slaughter.

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Materials and methods

- Experimental studies at the Swedish University of Agricultural Sciences' pig research facility
- Pigs stunned in batches of two: Behaviour (BEH) and EEG
- Pilot study: 2 days, 18 pigs
- Main study: 3 days, 54 pigs
- Total 72 pigs, mean age 86.5 days (range 82-90 days)
- Total 24 per treatment (12 BEH and 12 EEG), 50/50 females/males

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The test equipment

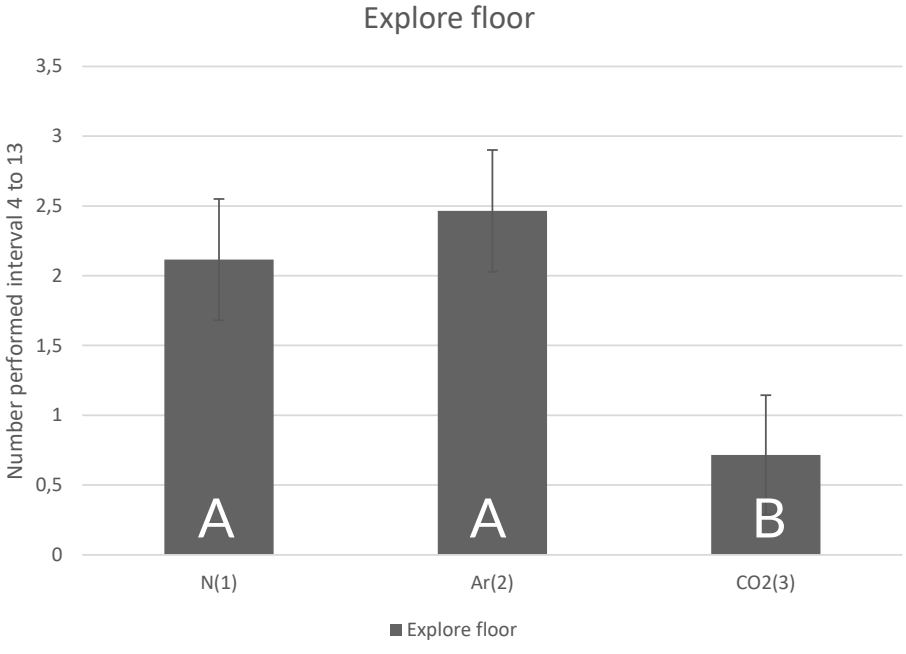
- Two modified foam boxes (by HEFT AB)
  - Size: L120xW80xH91 cm (floor area 0,78 m^2)
  - Control station
  - Two foam generators
  - Transparent lid and floor
  - Gas pulse system
- 50L gas bottle with compressed gas
- Geotech BIOGAS 5000 (UK) gas analyzer (oxygen level)
- GoPro cameras (above and below box)

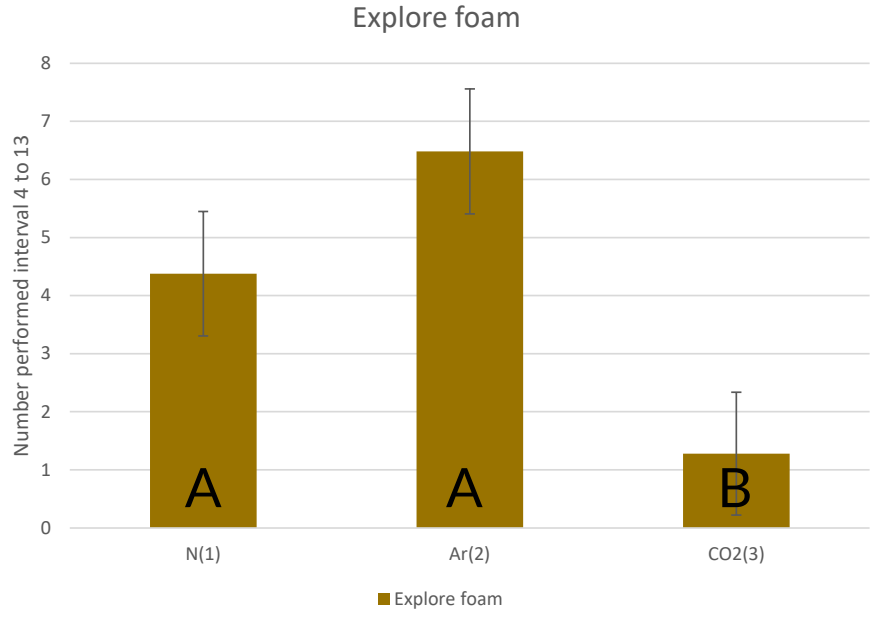
Image by HEFT AB

Data collection

- Behavioural observations from video recordings (above and below)
- Time to loss of balance (LOB)
- Time to loss of posture (LOP)
- Blood lactate

Explore floor and foam (LSM and STD)

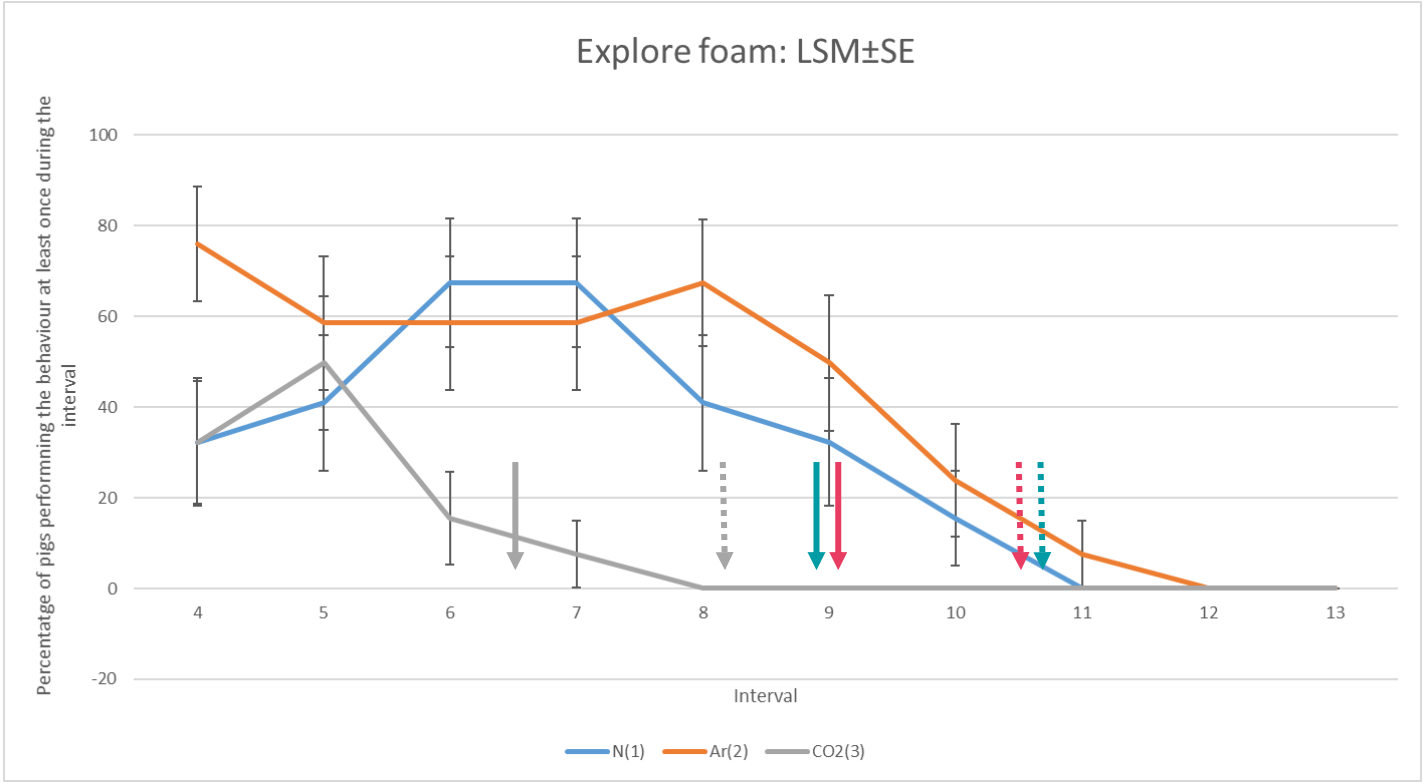




Explore foam (per interval)

LOB

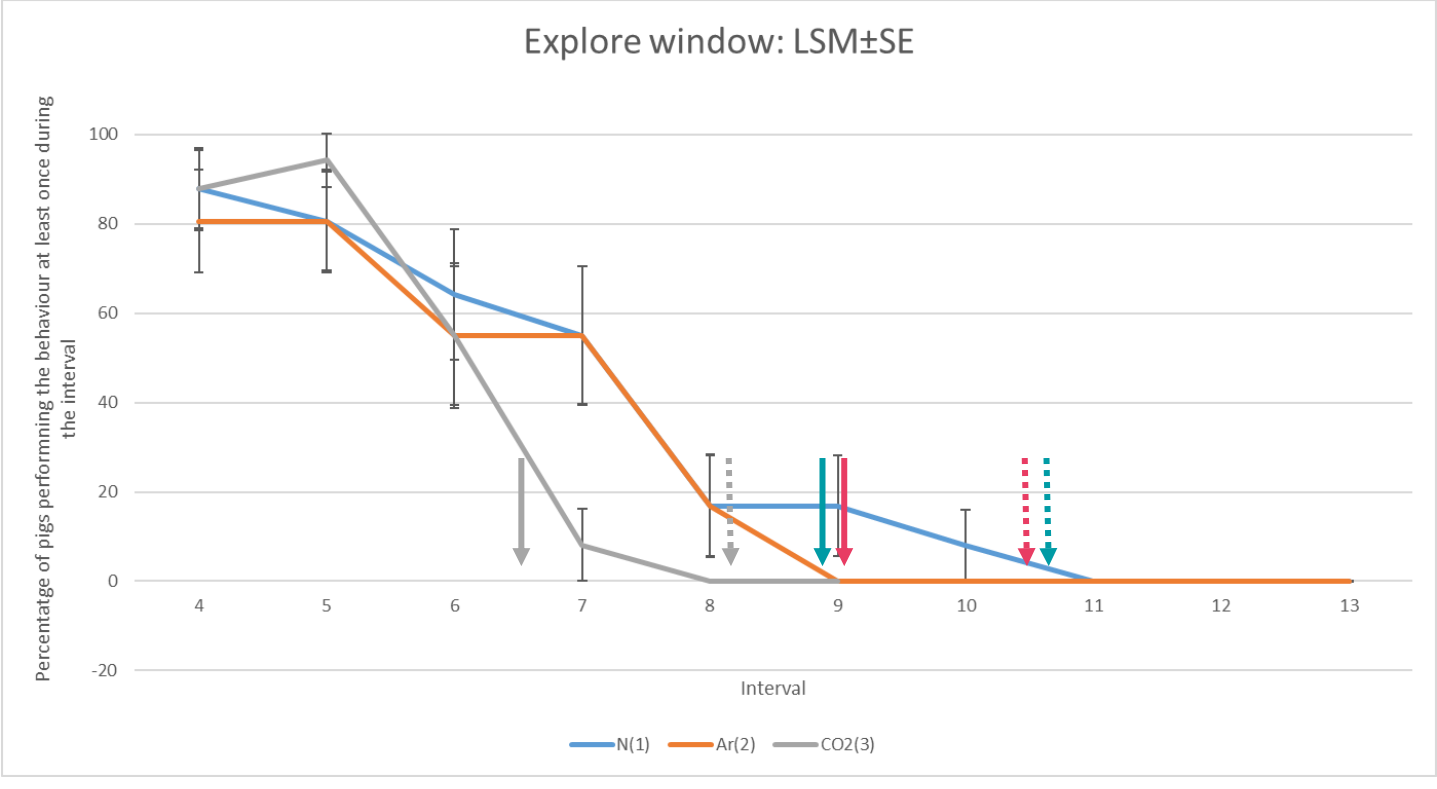
LOP



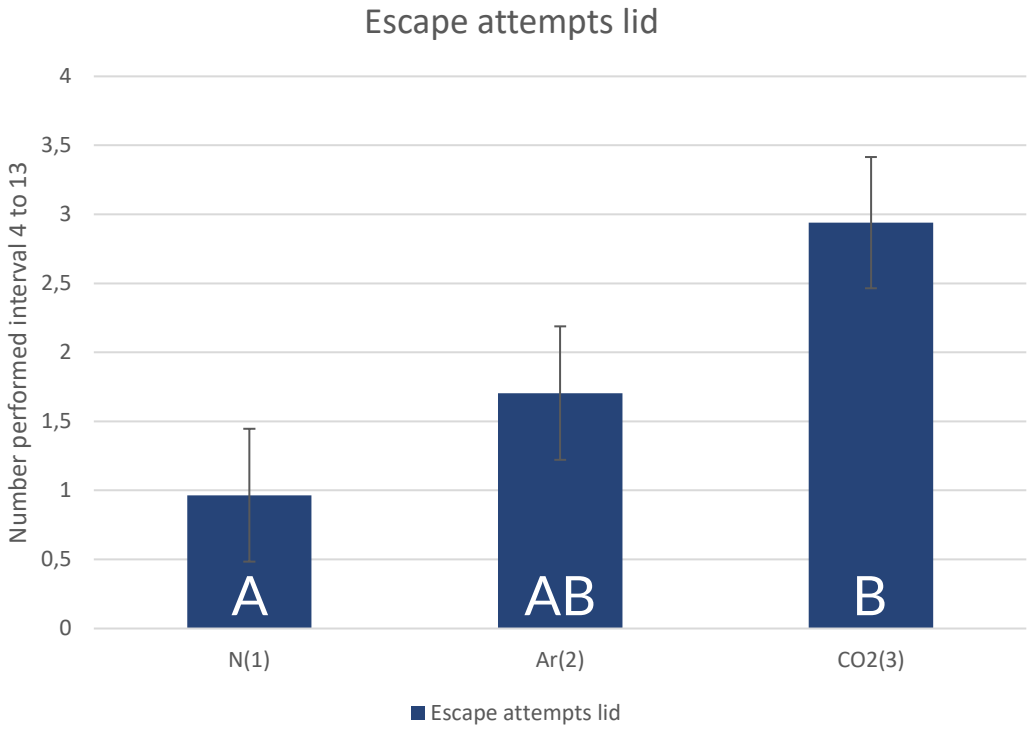
Explore window (per interval)

LOB

LOP



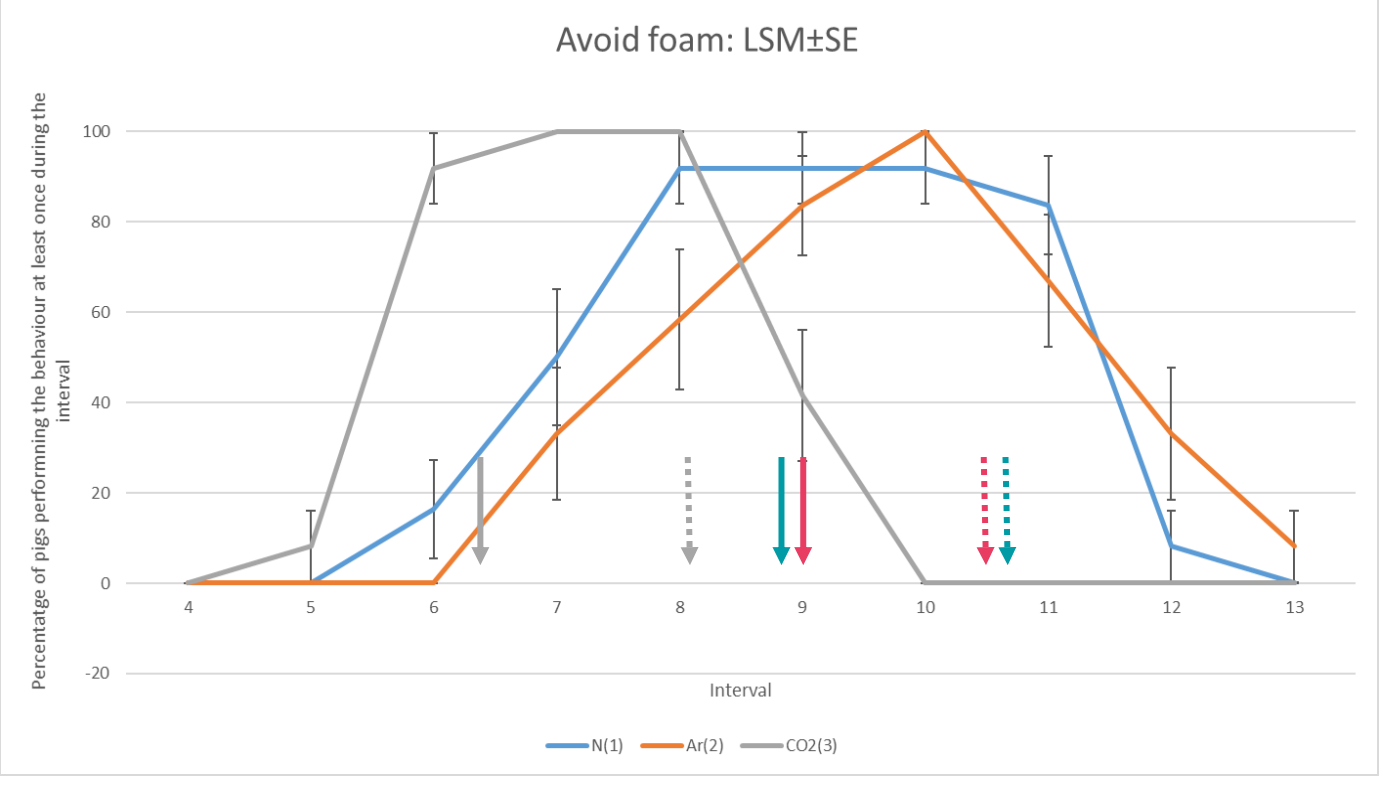
Escape attempts (LSM and STD)



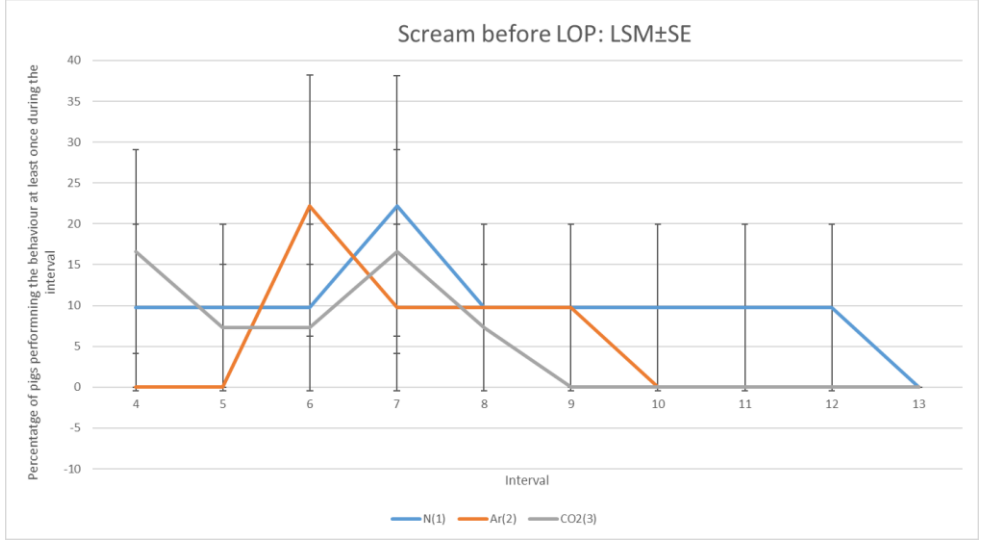
Avoid foam (per interval)

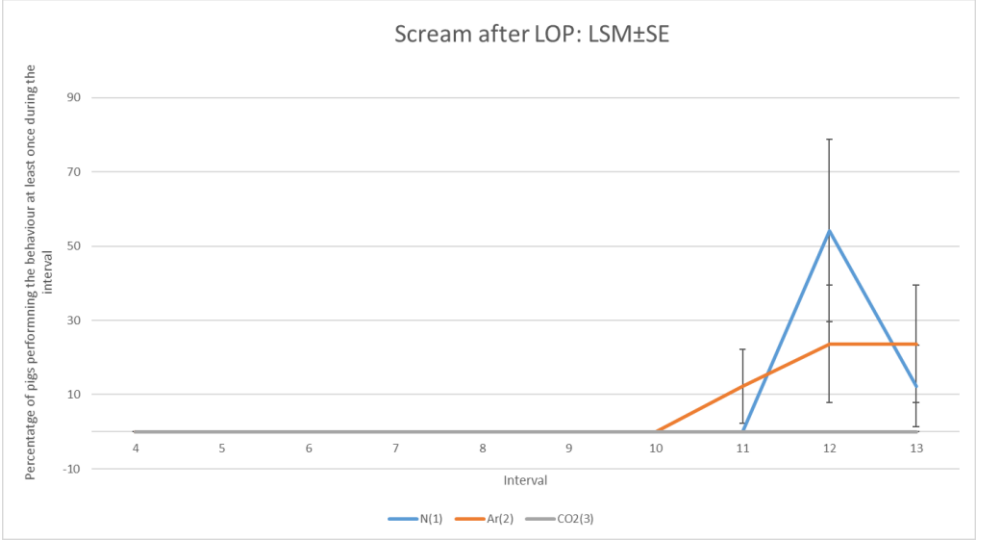
LOB

LOP

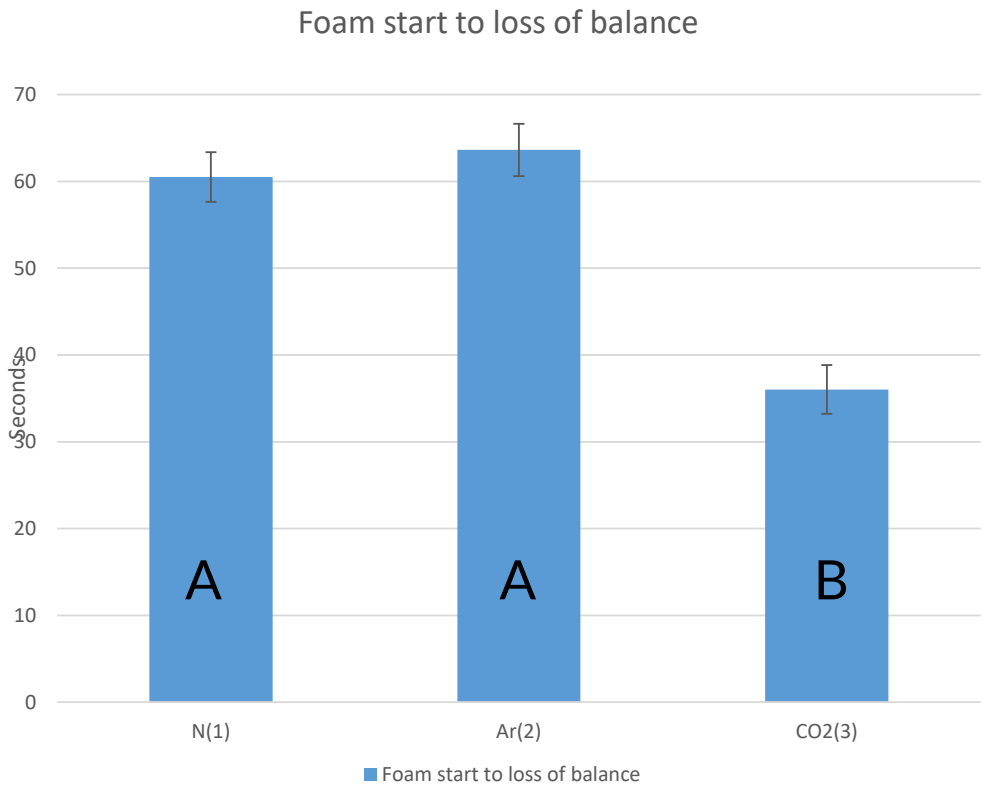


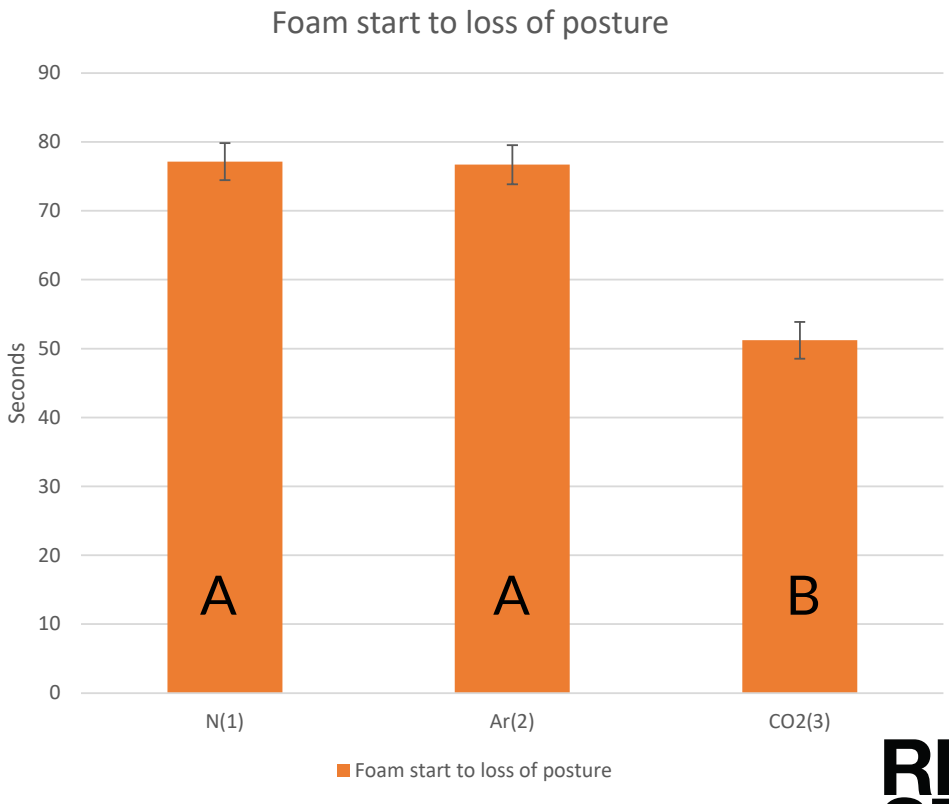
Screams before and after LOP (LSM and STD)



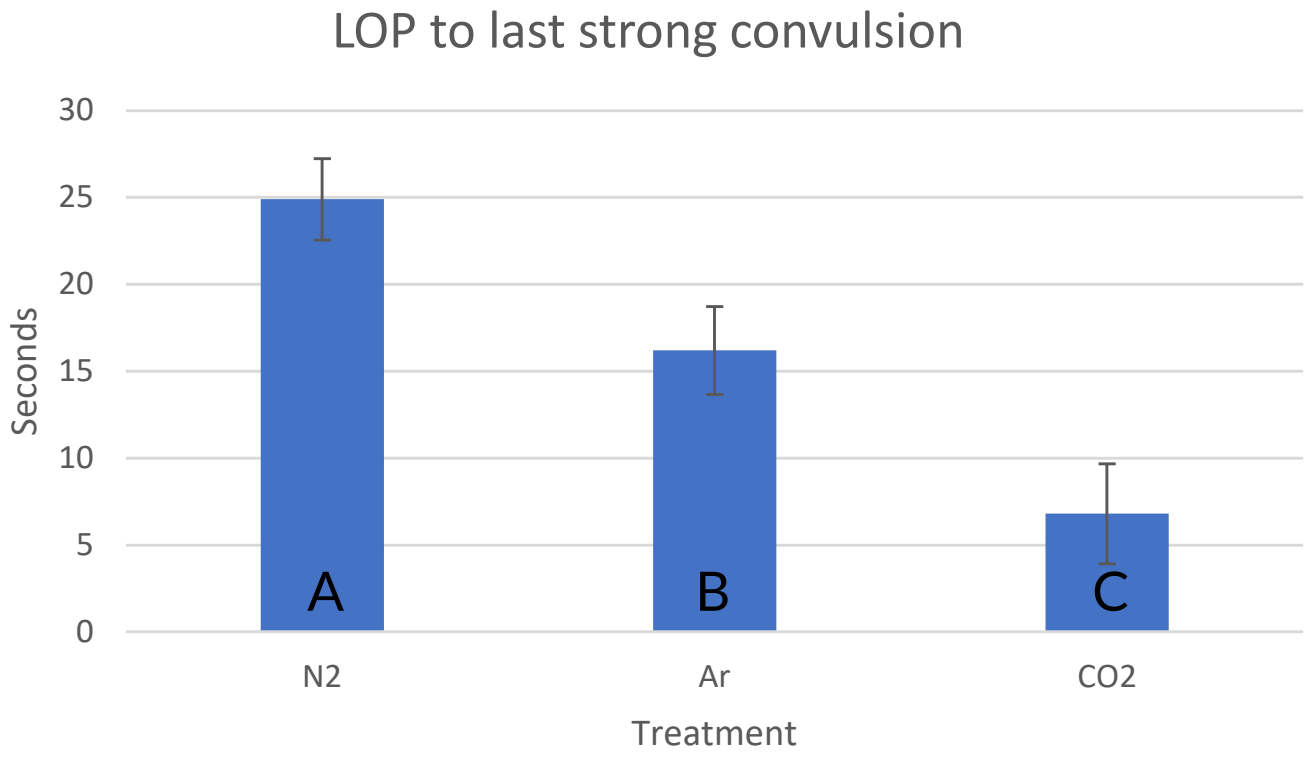


Time to LOB and LOP (LSM and STD)

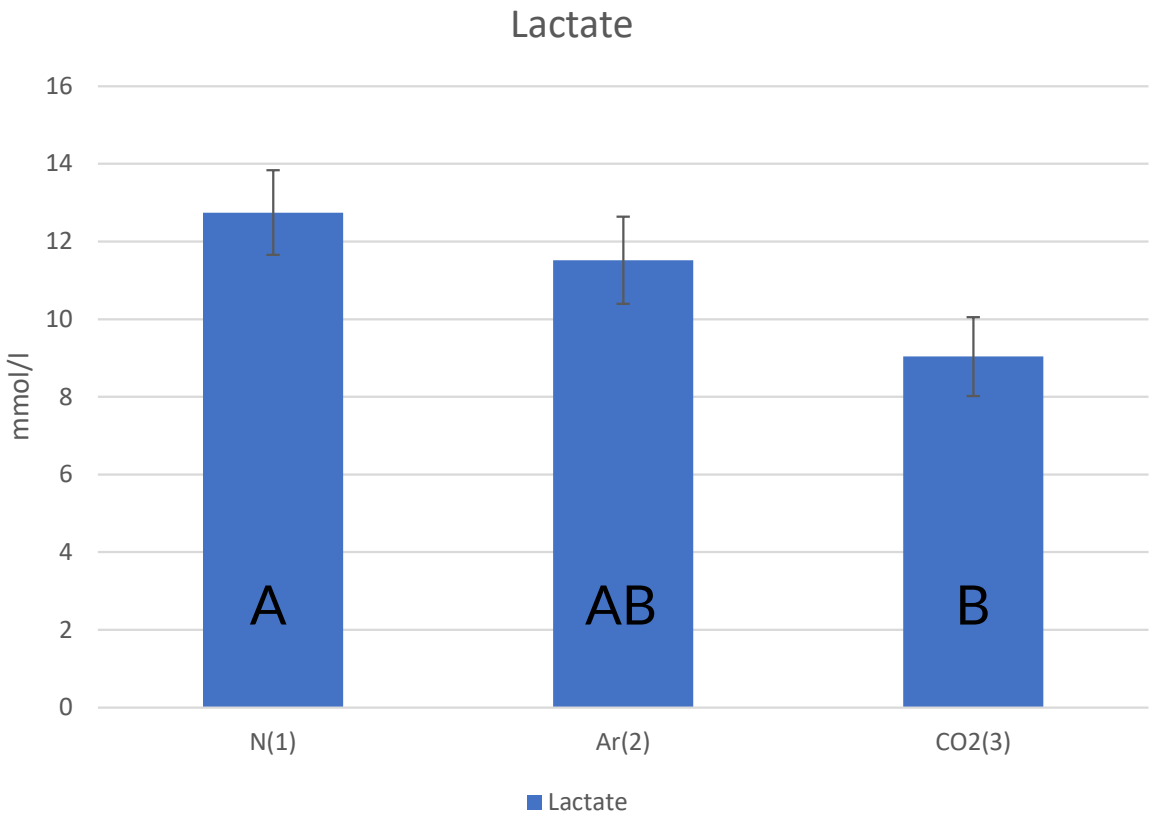




Time from LOP to last strong muscle contraction (LSM and STD)



Blood lactate (LSM and STD; n=8)



Conclusions

- Time to LOP was shorter in CO_2 compared to Ar and N_2
- The higher frequency of escape attempts for CO_2 compared to N_2 indicates that CO_2 is more aversive, which can also explain the lower frequency of exploring the foam and floor in the CO_2 treatment
- Pigs in the N_2 and Ar treatment screamed more, but screams commonly occurred after LOP (i.e. possibly unconscious screams)
- The higher blood lactate concentration in the N_2 treatment may indicate a higher stress levels or it may be a result of the stronger muscle contractions in the N_2 treatment
- Five minutes after start of foam, the pigs were assessed to be in deep unconsciousness or dead

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Thank you for your attention!

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