Question to EURCAW-Pigs: Pig stunning
12 May 2020

Question
Received: 24 March 2020

EURCAW-Pigs received the following issue and questions from a Ministry:

As a stunning method, CO_2 is allowed according to Regulation 1099/2009 and it is widely used. However it is known to be very irritating and induce experience of asphyxia which both reduce pig welfare. But are there relevant alternatives to CO_2 which are more welfare friendly? Electricity seems to be good alternative at stunning, however there are problems with meat quality issues and to our knowledge the driving of pigs to the stunner is clearly more difficult compared to using automatic doors driving small groups of pigs to a gas stunner.

The questions are therefore:
1. Are there alternatives to CO_2 stunning of slaughter pigs which are more welfare friendly?
2. What are the good and better practices for driving pigs to an electrical stunner?

Answer
Several EURCAW experts contributed to the response below. The EURCAW secretariat did the final editing, and may be contacted for queries: info.pigs@eurcaw.eu.

In short, the answers are:
- CO_2 at high levels (>80% by volume) is the most common gas applied in controlled atmosphere stunning systems for pigs. A CO_2 concentration at this level is highly aversive. Unconsciousness sets in within 30 seconds. To date, there is no commercially available alternative gas mixture for these systems.
- The other most common system involves electrical stunning. Unconsciousness is instant. However, animal welfare issues may arise whilst separating and driving individual pigs from the group pen to the restrainer. The degree of stress involved depends very much on the design of the raceway, and handling can be greatly improved by respecting physical components such as light, airflow, noise and other distractions.

Further information can be found in the background section below.

Background
- *Are there alternatives to CO_2 stunning of slaughter pigs which are more welfare friendly?*

Stunning is achieved through a neuronal function caused by hypercapnic hypoxia and diminishing pH in the central nervous system (Velarde et al., 2000a). In addition, stunning in the CO_2 chamber increases the anaerobic oxidative metabolism that increases glucose levels in the blood stream and triggers intracellular flow of K+ ions by hydrogen ions, causing metabolic acidosis. Exposure to CO_2 stimulates the respiratory rate and can lead to respiratory distress (Raj & Gregory, 1995).

Pigs generally enter the CO_2 stunning elevators (cradles) in groups of up to 8 pigs. They descend into the a high concentration CO_2 gas atmosphere (>80% by volume), which they find highly

aversive. Given the choice, they will avoid such atmospheres (Raj and Gregory, 1995; EFSA, 2004). When descending into the pit, pigs are seen to exhibit strong reactions for a period of up to 30 seconds. Carbon dioxide in high concentrations causes irritation of the nasal mucosa and exposure induces pain (Steiner et al. 2019). Velarde et al. (2007) estimate that 20 seconds or more may be required before the pigs have loss of posture.

Because of the aversive nature of CO2, research has focused on the use of alternative gases and gas mixtures in accordance with Annex 1 of the Council Regulation (EC) No. 1099/2009. Results from different research projects show that mixtures containing more than 15% CO_2 lead to an increase in retreat attempts compared to normal (atmospheric) air, which typically contains <0.05% CO_2 (Dalmau et al., 2010, Llonch et al., 2012; Verhoeven et al., 2016). Basically, there are two alternatives 1) exposure to pure inert gases such as Nitrogen or Argon with less than 2% residual oxygen and 2) 'anoxic' mixtures (so without O_2) with a maximum of 30% CO_2 and at least 70% N_2.

Regarding the first option it can be said that the exposure to inert gases is not applied commercially for various reasons (e.g. feasibility and stability of the gas, price of the gas or meat quality), and data concerning the exposure to nitrogen (N_2) or argon (Ar) are from experimental studies only.

Regarding the second option: the time to loss of consciousness is prolonged, and the stun duration is shortened after exposure to anoxic gases compared to CO_2 stunning (Raj et al., 1997, Raj and Gregory, 1996). Therefore, exposure duration in anoxic gas atmospheres used for stunning needs to be increased to safely prevent animals from regaining consciousness during bleeding (Machold et al., 2003). This means that the stun stick interval is very short, unless the exposure time is increased to at least 7 minutes. Both these situations are rather challenging in high speed slaughter lines. Lower through-put rates rate will reduce the economical perspective and on the other hand a short stun to stick interval will increase the risk of animals recovering consciousness.

- *What are the good and better practices for driving pigs to an electrical stunner?*

Given that slaughter lines operate at high speeds, the main animal welfare concern before electrical stunning is moving pigs from a group into a single line into the stunner. Pigs can be reluctant to move individually, and there is a high risk that the staff will move the pigs into the single file by applying a lot of pressure. The use of e.g. electric goads leads to considerable stress, fear and pain. To facilitate ease of movement, the speed of moving, the design of the raceway, environmental aspects such as light, noise and airflow, and the handling of the pigs are relevant for pigs to move into the single file.

The design of the raceway

Pigs prefer to move into light areas and they react sensitively to head-on airflows and may be resilient to move forward into a draft. Management of light and airflow can encourage pigs to move into single files before stunning. Disturbing noise should be avoided e.g. metal gates banging on metal (by rubber protection) or noises from hydraulic slaughter apparatus. Pigs will move more easily from the group pen into a single file if the chute is partially empty and there is no risk of pigs jamming at the entrance. The design of the raceway and especially the entrance

into the stunner is often a limiting factor. Pigs have limited vision and therefore need time to explore the route they have to take into the raceway.

Pigs prefer to move in groups or closely follow companions, especially in fearful situations. A funnel shaped entrance will encourage the animals to enter the race side by side resulting in jamming in the race. Off set steps before the single file race can help to prevent jamming (fig 1).

Design of the raceway like a carousel or curved raceways can facilitate the flow of the pigs (Jones 1999; Grandin 1990) and therefore reduce the level of fear. The raceways and entrance to the restraint should always be clean to maintain movement of animals without the need to use force and avoid animals slipping and falling (Grandin, 2012).

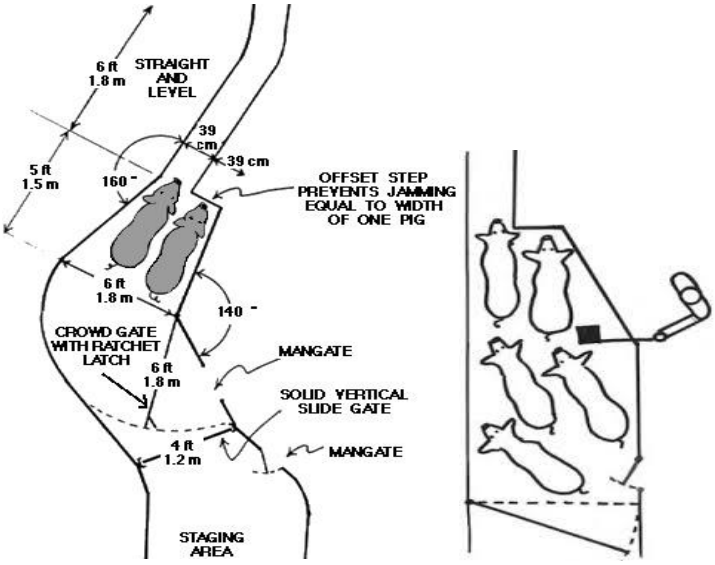

Fig. 1: Off-set step before single file race (Grandin, 2019)

Speed of operation

Reducing the loading speed and giving animals the time and opportunity to go from a group into a single line will prevent or reduce the level of fear and stress.

Movement of pigs is easier when carried out in small groups, according to design of facilities available (Dalla Costa et al., 2019). The difficulty of handling and moving of pigs increase as the group size increases. Ideally, operators should be able to reach all the animals in the group, if required to facilitate the ease of movement.

Animals have a flight zone and "point of balance". The "point of balance" is at the animal's shoulder, depending on where the handler stands in relation to the point of balance, the pig will move forward or backup (Dalmau et al., 2009). Walking in the opposite direction to the pigs thus leaving their flight zone encourages them to move forward (see Fig. 2). If the crowd pen before the chute is not too crowded and the gates are not closed tightly, the crowding pen serves as "passing through" pen to the chute (Grandin, 2019). Groups of pigs being moved should be small which requires more walking for the staff. Double races have the advantage that pigs are not isolated before the chute and walking beside each other in two parallel chutes promotes pigs`

natural following behaviour. The sides in double chutes should be solid and the middle partition "see through" (Grandin, 2020).

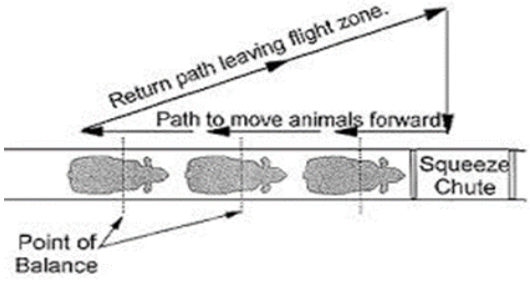

Fig. 2 Flight zones (Grandin, 2019)

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