Position on alternatives to high concentration CO_2 for the slaughter of pigs

The Problem

Pigs are most commonly stunned using carbon dioxide gas (CO_2) because it allows for group stunning and a high throughput. CO_2 is used during the slaughter process for 90% of pigs slaughtered in England and Wales[1], and an estimated 67% of pigs slaughtered in the EU[2]. Small groups of pigs are moved into a gondola or dip lift cage which is then lowered into a well filled with a high concentration of CO_2 (usually 80–90%). Exposure to high concentrations of CO_2 causes metabolic acidosis, lowering blood and cerebrospinal fluid pH, which inhibits spontaneous brain activity and leads to gradual loss of consciousness and sensibility[3]. Time to loss of consciousness of pigs exposed to 80% to 90% CO_2 by volume is said to be within 30 s[3], although this varies between individuals and gas concentration – the time to loss of consciousness in pigs exposed to 80 and 95% CO_2 by volume ranges from 39 – 61 s and 21-44 s respectively[4]. Death of most pigs will occur after 3-5 minutes exposure to an atmosphere containing at least 90% CO_2 by volume[3].

For decades, scientific evidence has consistently shown that CO_2 stunning causes significant suffering. In the period before pigs lose consciousness, they experience pain, fear, and respiratory distress. EFSA (2020)[3] highlight three mechanisms by which exposure to high concentration CO_2 impacts the welfare of pigs before they lose consciousness. Firstly, pain is caused when CO_2 dissolves in moisture on respiratory and ocular membranes, forming carbonic acid, which irritates mucosal surfaces causing a burning sensation on the eyes and throat. Secondly, the high CO_2 levels lead to air-hunger, an intense urge to breathe and a sensation of suffocation, which is highly distressing. Finally, CO_2 directly stimulates acid-sensing ion channels (ASICs) in the amygdala, a brain region linked to fear and anxiety, amplifying the aversive experience. Behavioural responses to high-concentration CO_2 demonstrate that exposure is perceived by pigs as highly aversive. In repeated tests using a dip-lift system, pigs habituate to the crate when lowered into air, but those exposed to CO_2 (at 70% or 90%) become increasingly reluctant to enter and show more retreat attempts, especially at 90% CO_2[5]. Similarly, most pigs refused to enter a 90% CO_2 atmosphere to obtain food, even after 24 hours of fasting, unlike when exposed to 90% argon, or 30% CO_2[6]. During stunning with either 80% or 95% CO_2, pigs display retreat attempts, jumping, and gasping before loss of consciousness[4]. EFSA (2020) note that for CO_2 stunning of pigs, "*There are no preventive or corrective measures to the pain, fear and respiratory distress caused by the exposure to high CO_2 concentrations as this is inherent to the stunning method.*[3]"

To be considered humane, stunning methods must either be non-aversive or cause instantaneous loss of consciousness which lasts until death supervenes. CO_2 stunning is both aversive and not instantaneous. For this reason, EFSA (2020)[3] recommended that "*Exposure to CO2 at high concentration … should be replaced by exposure to other gas mixtures that are less aversive*." Additionally, the recently released position of the UK Animal Welfare Committee

(2025) recommended that "*to prevent pigs experiencing avoidable pain, distress or suffering at slaughter*" CO_2 as well as CO_2 in combination with other gases "*should be prohibited as a method of stunning for pigs*"[7]. While no country has yet banned the use of CO_2 for the stunning of pigs, the UK Department for Environment, Food & Rural Affairs (DEFRA) recently published their "Animal welfare strategy for England (2025)[8]" which includes the objective to phase out this practice, and a number of EU countries are said to be investigating alternatives, including Germany and the Netherlands[9].

The Alternatives

Inert gases, such as argon, helium, or nitrogen, have been proposed as promising alternatives to CO_2 as they induce unconsciousness through hypoxia without activating pain receptors or causing respiratory acidosis. Unlike CO_2, they do not form carbonic acid on mucosal surfaces or trigger intense air hunger, so pigs experience minimal irritation and discomfort before losing consciousness. Additionally, while welfare concerns have been raised about the pre-stun phase for the electrical stunning process - where pigs are traditionally moved in single-file into the system which is stressful and results in the excessive use of goads - the stunning method itself is not as aversive as CO_2. The recently concluded EU-coordinated PigStun project[10] was established to look into promising alternatives to encourage EU pig slaughterhouses to move away from using high concentration CO_2 for the slaughter of pigs. The PigStun project investigated four possible alternatives to the current CO_2 systems: 1) the possibility of retrofitting existing CO_2 CAS (Controlled Atmosphere Stunning) systems to use argon gas, 2) a newly designed CAS system using helium, 3) improvements to the pre-stun phase to reduce stress in CAS systems, and 4) an improved electrical stunning system to reduce the negative experiences as the animals move through the system in the pre-stun phase.

Pigs stunned in systems using argon and helium showed significantly better welfare outcomes compared to those stunned using high concentration CO_2 - pigs showed less respiratory distress and reduced aversion in the argon and helium systems in the period before loss of consciousness[11]. While the time to induction of unconsciousness was longer in the alternative systems compared to CO_2 systems, the pigs experience significantly less suffering during this time, and all systems were able to achieve an effective stun[11].

Argon is a more promising alternative for systems currently using CO_2. This is because argon can be re-produced easily and existing CO_2 CAS systems can be retrofitted to use argon, whereas helium is a more limited resource and would require new systems to be built.

Both the Optimised CAS system and the Improved Electrical Stunning (IES) system (developed by Eyes on Animals) likely resulted in reduced pre-stun stress[11]. Enhanced welfare can be achieved by focusing on pre-stun handling, raceway design, and smooth movement of pigs through the system. Key improvements in the IES system include installing additional stunning units to reduce the pressure on throughput per stunner and allowing pigs to be moved in small groups through the system. Pigs can freely choose which stunner to enter and enter into adjacent stunners in parallel so that they always have visual contact with other pigs.

Additionally, a lower-voltage electric prod is permitted only at the point where pigs step onto the stunner conveyor, reducing the frequency and intensity of painful experiences compared with handling in traditional electrical stunning systems. The PigStun project concluded that these improvements were very likely to have reduced the pre-stunning stress compared to conventional stunning systems (CO_2 and electrical stunning)[11].

CAS systems using inert gases, such as argon, have been shown to significantly reduce stress and pain during stunning for pigs compared to high concentration CO_2 and are a feasible to implement within existing CO_2 systems. Improvements in the pre-stun handling of pigs can further reduce stress prior to stunning in both CAS systems with inert gases and electrical stunning systems. Compassion urges the industry to move away from CO_2 stunning and adopt more humane alternatives that align with both scientific evidence and ethical responsibility.

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