Swine welfare at slaughterhouses in Valle de Aburrá (Colombia)

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ABSTRACT

The World Organization for Animal Health (OIE) makes recommendations related to the slaughter of animals for human consumption. Colombia has some regulations on animal welfare in slaughterhouses. This study assessed welfare of pigs in slaughterhouses in Valle de Aburrá, Colombia using measures from existing welfare protocols (Welfare Quality: Assessment protocol for pigs; Recommended Animal Handling Guidelines and Audit Guide for Cattle, Pig and Sheep).

The objective was to determine the degree of compliance with some welfare protocols recommendation (Welfare Quality. Assessment protocol for pigs and Recommended Animal Handling Guidelines and Audit Guide for Cattle, Pig and Sheep) in regards to welfare of pigs in slaughterhouses in Valle de Aburrá, Colombia.

A cross-sectional study was conducted using data from four slaughterhouses during 2017. Univariable analysis was performed, depending on the type of variable. Frequency distribution was assessed for descriptive variables, while quantity variables were assessed by central tendency and dispersion measures.

It was found that electric prods are often used for moving pigs to lairage pens and to stunning area, the animals remain in lairage pens in too high stocking densities and also some signs related to inadequate loss of consciousness during stunning were shown. Some pigs were kept more than 10 h in lairage pens and some did not have access to water. Skin lesions occurred in 93.6% of the observed animals.

It is concluded that the assessed slaughterhouses do not manage to keep animal welfare on a required level.

1. Introduction

Animal handling prior to slaughter is one of the most stressful circumstances for pigs (Averós, Knowles, Brown, Warriss, & Gosálvez, 2008; Warris, 1994; Warriss, 2003). Several protocols are available to assess animal welfare in slaughtering plants. The "Welfare Quality® assessment protocol for pigs", developed by The European Welfare Quality Project, and the "Recommended Animal Handling Guidelines and Audit Guide" developed by the American Meat Institute/Animal Welfare Committee are among such available protocols. Those protocols have been developed to evaluate and control the quality of animal welfare both in farms and slaughterhouses. Abattoir protocols comprise a set of observations used to evaluate animal welfare during the different stages of transit, such as truck downloading, lairage in holding pens, on the way to stunning and during stunning.

The World Organization for Animal Health (OIE) issued recommendations on, for instance personnel training, ethology, suppression of distractions like reflections on wet floors, dark entrances to ramps, corridors, stunning compartments or immobilization corridors, movement of people or material in front of animals: uneven floors, restraint and containment of animals, design of facilities, animal care, stunning and slaughtering methods to ensure welfare during slaughter of animals for human consumption (World Organization for Animal Health, 2016). Colombia has some regulations in slaughter plants, like Decree 2278 of 1982 which includes issues related to stunning methods, lairage, and emergency slaughter; Decree 1500 of 2007 and resolutions 240, 241 and 242 of 2013, include directions to guarantee animal welfare in abattoirs (Instituto Colombiano Agropecuario ICA 2007; Ministerio de la Protección Social. 2007). The objective of this study was to establish the level of compliance with welfare protocols in slaughtering plants of Valle de Aburrá, Colombia during 2017.

2. Material and methods

This study was conducted during 2017 at four abattoirs approved by the Colombian national institute for food and drug surveillance (INVIMA) in Valle de Aburrá. Probabilistic sampling -stratified per abattoir was used to select the animals for analysis. The study was endorsed by the ethics committee for the use and care of animals (CICUA) of CES University (Medellin, Colombia), as stated in Act...
The stunning method used, the time it took (time inside the CO2 chamber or time that electrical current was used), and the time between stunning and slaughtering were recorded. The level of consciousness of the animal was assessed by evaluating the presence of corneal reflex, rhythmic breathing, righting reflex, and vocalizations.

2.7. Postmortem lesions

Postmortem lesions were organized according to macroscopic appearance (coma-shaped, rectangular, linear, rhomboid, diffuse, hematomat and petechiae) and the anatomical region affected (head, back, loin, medium and ham). The average size of dermal lesions was categorized as (≤0.5 < 1.99 cm); (≤2 < 5 cm); (≤ 5.1 < 10 cm); (> 10.1 < 15 cm) or larger than 15 cm (Varón-Alvarez, Romero, & Sánchez, 2014).
2.8. Statistical analysis

Univariable analysis was performed, depending on the type of variable. Frequency distribution was assessed for descriptive variables, while quantity variables were assessed by central tendency and dispersion measures. The statistical analyzes were conducted using Epidat 3.1 and SPSS (version 21) programs.

3. Results

During truck unloading at the abattoir, electric goads were used in 6.7% of the animals. Likewise, 16.7% showed thermoregulation difficulties expressed by panting, and 18.5% animals fell in the process (Table 2).

In lairage pens, 9.8% of the animals stayed more than 10 h, while 36.6% were kept overcrowded, and 12% had no access to water (Table 3). Similarly, 19% of the pigs showed thermal discomfort expressed either by panting or huddling, and 34.1% produced high number of vocalizations during the stay, as shown in Table 4.

Regarding to stunning, 75% of the times it was performed by either head-head or head-heart electric stunning. In terms of its effectiveness, on average 9.2% of the animals attempted to regain a standing position after stunning (Tables 5 and 6).

Finally, 93.6% of the animals presented some type of postmortem injuries. Lesion size was between 5.1 and 10 cm in the loin, and 10.1–15 cm in the ham, respectively (Table 7).

4. Discussion

During truck unloading at the abattoir, ease of movement can be assessed by the percentage of animals that slip and/or fall, which is mainly associated with inadequate facilities or driving to lairage pens (Grandin & Chambers, 2001a). In this study, on average, 33.8% of pigs slip and 18.5% fell, which is much higher compared to reports from European (Spanish and Italian) and Brazilian slaughter plants, which average 2.1% falls and 13.9% slips, respectively (Dalmau et al., 2016).

Regarding thermoregulation, 16.7% animals showed panting despite being transported and unloaded either at night or at dawn, with average temperature ranging between 16 and 20°C ("Hourly Weather for Medellin - AccuWeather Forecast for Antioquia, Colombia (ES)" 2017). These numbers differ from Brazilian and Canadian reports, where panting was only 8% and 0.6% respectively (Dalmau et al., 2016; Rocha et al 2016).

In the holding pens, 18.4% of the animals was housed at low density (more than 1.00 m²/pig), which could have been associated to a slow flow of animals arriving to the abattoirs. Conversely, 36.6% of the animals were housed at high densities, similar to reports from Portugal, Italy, Finland, Brazil and Spain, in which average density was 0.71 m²/pig (Dalmau et al., 2016). Considering that overcrowding elicits agonistic behaviors (e.g. fights and bites) it is imperative to offer animals enough space to increase comfort when walking to drinking areas or perform exploration behaviors (Rabaste et al., 2007; Velarde & Dalmau, 2012).

In relation to water, there should be a drinker per 10 animals (Welfare Quality. Assessment protocol for pig 2009, Dalmau et al., 2016; Veehouderij, 2009). Although the number of pigs/drinker was not assessed, we observed that 12.0% of the animals did not have access to water, which predisposes to panting at high temperatures (Huynh et al., 2005). Panting in the holding pens was observed in 7.6% of the pigs, which is much higher than that reported in Spain, Finland and Brazil, where panting was 0.16%, 0.17% and 0.33%, respectively (Dalmau et al., 2016). It is known that lack of water during lairage can negatively affect animal welfare generating dehydration which can produce hyperthermia, panting and death (Recerril-Herrera et al., 2009; Brown, Knowles, Edwards, & Warriss, 1999; Schaefer, Jones, & Stanley, 1997).

Huddling behavior (percentage of pigs that were touching on top more than 50% of its body with another pig when they were resting) was observed in 11.4% of the animals in lairage pens, indicating that temperatures were below optimum, which should range between 15 and 18°C (Velarde & Dalmau, 2012). Other studies have reported between 3.76% and 13.0% huddling (Dalmau et al., 2016; Faucitano & Geverink, 2003). According to our results, ventilation and/or...
temperature in the holding pens of abattoirs in Valle de Aburrá should be improved taking into account precipitation, environmental temperature, air drafts and daily flow of animals.

Moving of animals through slaughter plants should be free from slips and falls. This can be achieved with non-slip floors in pens and corridors towards stunning areas (Gallo & Tadich, 2008). While slips and falls should not exceed 5% (Grandin, 2010), we observed 29% slips and 16.4% falls. This is an indication of infrastructure deficiencies and animal handling problems (Muñoz, Strappini, & Gallo, 2012).

Proper handling can be further compromised by the use of electric goads inside the slaughterhouse because those devices greatly stress the pigs. The OIE has banned this practice for the handling of horses, sheep and small pigs (World Organization for Animal Health, 2016). Its use is appropriate only when animals refuse to move, lie down, and have no illnesses that impede walking (Munteuffel, Puppe, & Schön, 2004). The OIE approves the use of battery-operated electric goads with a voltage not exceeding 30V (Grandin, 2001). An “excellent” score is given when used in less than 5% of the cases (Grandin, 2013). In this study, electric goads were used in 6.7% of the pigs driven from trucks to lairage pens, and in 4.7% of pigs driven from pens to stunning areas. These results are similar to other studies conducted in Colombia, in which excessive use of electric goads has been reported (Bourguet, Deiss, Tannugi, & Terlouw, 2016; Verhoeven, Gerritzen, Hellebrekers, & Kemp, 2015). Respiration should stop after gasification (CO2 overload/lack of O2) due to decreased neural activity of the brain and the brainstem. Respiratory arrest should also occur after electrical stunning following propagation of the epileptic attack to subcortical regions (thalamus and brainstem) and some cortical areas (Devinsky, 2004; Verhoeven et al., 2015). We observed rhythmic breathing after stunning at 20.8% when the pigs were stunned by head-to-head electric shocks; 23.8% using head-to-heart electric shocks; and 26.5% using CO2 chamber.

Corneal reflex is tested by lightly touching the cornea. This reflex involves transmission of sensory information to the brainstem causing a motor response. When present, the eyeball is slightly retracted and the eyelid closes, passing the sensory information via trigeminal nerve (Cruccu & Deuschl, 2000). Corneal reflex is considered reliable to evaluate the state of unconsciousness after slaughter. Any interruption of the underlying neural circuit modifies or removes the reflex. If

### Table 6

| Variable              | Category | Frequency (n = 451) | Percentage % | Frequency (n = 113) | Percentage % | Frequency (n = 113) | Percentage % |
|-----------------------|----------|--------------------|--------------|--------------------|--------------|--------------------|--------------|
| Corneal reflex        | Yes      | 67                 | 29.7         | 35                 | 31.0         | 38                 | 33.6         |
| Rhythmic breathing    | Yes      | 47                 | 20.8         | 27                 | 23.8         | 30                 | 26.5         |
| Attempts to regain a  | Yes      | 15                 | 6.6          | 11                 | 9.7          | 13                 | 11.5         |
| standing position     |          |                    |              |                    |              |                    |              |
| Vocalizations         | Yes      | 40                 | 17.7         | 22                 | 19.4         | 25                 | 22.1         |

### Table 7

| Variable              | Category | Frequency (n = 451) | Percentage % | Frequency (n = 113) | Percentage % | Frequency (n = 113) | Percentage % |
|-----------------------|----------|--------------------|--------------|--------------------|--------------|--------------------|--------------|
| General lesions       | Yes      | 422                | 93.6         |                    |              |                    |              |
| Head lesions          | No       | 29                 | 6.4          |                    |              |                    |              |
| Back lesions          |          |                    |              |                    |              |                    |              |
| Loin lesions          |          |                    |              |                    |              |                    |              |
| Ham lesions           |          |                    |              |                    |              |                    |              |

According to Munteuffel et al. (2004), animal vocalizations are indicative of problems related to the equipment or improper handling. Increased vocalizations are related with the use of electric goads, slips, falls, lack of training of staff, nervous animals, and inadequate calibration of stunning equipment (Grandin, 2001; Grandin, 2010; Grandin, 2013; Munteuffel et al., 2004). In our study, vocalization was high, with 34.1% of the pigs vocalizing during the stay in lairage pens, which could be related to mix animals with other unknown animals and the high density that was used in 36.6% of the pigs, increasing agonistic behaviors (e.g. fights and bites) and consequently high vocalization (Rabaste et al., 2007; Velarde & Dalmau, 2012).
Conclusions

Animal welfare at abattoirs in Valle de Aburrá is deficient, since pigs are not offered optimal slaughtering conditions, some of them did not have access to a water supply, others were kept in high density and most of the animals had skin injuries. Interestingly, stunning methods are not properly working in these abattoirs. Possible reasons for this are a lack of maintenance of infrastructure, lack of training of the personnel, and inadequate calibration of equipment, among others. More studies are needed to better understand the causes of these problems. Thus, it is important to continue promoting Colombian regulations regarding proper infrastructure requirements, personnel training and calibration of equipment that abattoirs must fulfill for suitable operation in order to ensure animal welfare and quality of the end product.

Conflict of interest statement

None of the authors has any financial or personal relationships that could inappropriately influence or bias the content of the paper.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.vjas.2018.07.006.

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