

## THE INFLUENCE OF GENETIC BACKGROUND AND STUNNING SYSTEMS ON WELFARE AND MEAT QUALITY OF BRAZILIAN SWINE

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### Background

Genetic background, preslaughter handling and stunning methods combined with slaughter techniques and chilling systems affects animal welfare and meat quality respectively.

Stunning systems for pigs (CO<sub>2</sub> or electrical) and its relationship with animal welfare and meat quality has been on concerning during the last three decades. There are still some aspects to be understood and better defined for the scientific community.

In Brazil there are both stunning systems for pigs operating commercially, however the behavior of the main Brazilian breeds in relation to them are not well studied.

### Objectives

Investigate the influence of pre-slaughter stunning (CO<sub>2</sub> and electrical) on animal welfare (ciliar reflex; cortisol; creatine phosphokinase; lactate) and meat quality (pH; drip loss and color) from three Brazilian genetic swine.

### Material And Methods

**Animals.** A total of nine hundred and fifty pigs divided in two experimental blocks constituted of three genetic lines broadly marketed in Brazil (A, B, and C) were used in this experiment.

**Slaughter.** The fasting period adopted in this experiment varied from 14 to 16 hours. Pigs were transported by a commercial haulier in two-tiered transport vehicle at stock density of 240 kg/m<sup>2</sup>. Lairage times varied from 2 to 3 hours and pigs from each breeding were stunned in a random way either with the electric manual system (220V, 60HZ and 1,4A) marketed by the company Karl Schermer or with automatic gaseous system (CO<sub>2</sub>), model COMBI marketed by the company BUTINA.

**Measurements.** At exsanguination a sample of heparized blood was collected for determination of creatine phosphokinase (CPK), lactate and cortisol. The pH values were measured on post-rigor (pH<sub>24h</sub>) *semispinalis capitis* (SC) and *semimembranosus* (SM). Surface L\*, a\* and b\* colour values were determined on the post-rigor *longissimus dorsi* (LD) using Minolta CR-2000 color meter and internal reflectance (light scattering) was evaluated with the Hennessy Grading System. Drip loss (RASMUSSEN & ANDERSON, 1996) was carried out on the post-rigor *longissimus dorsi* (LD).

### Results And Discussions

The results of effectiveness of stunning systems are given in Table 1. As far as the efficiency of the stunning systems is concern carbon dioxide (CO<sub>2</sub>) was more efficient (2,86%) than electrical (11,57%) in relation to ciliar reflex evaluated 40 seconds after the stunning. HOLST (2003) reported the ideal time for animals to present signs of ciliar reflex as 54 seconds after stunning. Take into consideration it is suggested that the conduction of the animals from the crowded pen to single file should have some adjustments to improve the evaluated aspect.

The statistical results of blood profile and meat quality for both stunning systems are shown in Table 2. The plasmatic levels of cortisol and lactate was significantly higher for pigs stunned electrically, demonstrating that the this system was more stressful than carbon dioxide (CO<sub>2</sub>). Concerning to the levels of creatine phosphokinase the gaseous system presented a light increase in relation to the electrical one and this difference probably was due to the environmental factors. The stunning systems did not affect the meat colour (L\*, a\* and b\*) negatively although CO<sub>2</sub> resulted a lighter meat (L\* = 45,61) than electrical (L\* = 43,51), meat colour is considered normal based on classification (PSE - L\* = 55,5±0,6; RSE - L\* = 47,3±0,7; RFN - L\* = 45,5±0,7 e DFD - L\* = 38,3±0,7) proposed by WARNER *et al.*, (1995). The light scattering measurements accomplished on the killing line and 24 hours *post mortem* with the Hennessy Grading System also resulted values correspondent to the normal meat. No significant differences between stunning systems were found in drip loss, although it can be observed that CO<sub>2</sub> presented values slightly lower than electrical. SILVEIRA (1997) had also reported small differences in meat quality (pH and colour) in relation to carbon dioxide (CO<sub>2</sub>) and electrical stunning systems applied in swine.

Table 3 shows statistical results of blood profile and meat quality for each breeding considering the carbon dioxide pre-slaughter stunning. There were considerable differences between means of blood stress indicators (CPK, lactate and cortisol, p < 0.05) and meat quality (pH - p < 0.05 and drip loss - p > 0.05). This indicates the most favorable results for genetic A.

### Conclusions

The present study indicates that the electrical pre-slaughter stunning appraised was less effective and more stressful than automatic carbon dioxide (CO<sub>2</sub>). Genetic A demonstrated to present advantages as far as blood profile and meat quality is concern.

Table 1. Effectiveness of the stunning system (% ciliar reflex)

| Genetic | N   | Interval | Stunning System | % ciliar reflex | % Strong Contraction |
|---------|-----|----------|-----------------|-----------------|----------------------|
| B       | 71  | 40 seg.  | CO2             | 0%              | 2.82%                |
| B       | 72  | 40 seg.  | ELECTRIC        | 12.5%           | 22.22%               |
| A       | 63  | 40 seg.  | CO2             | 3.17%           | 7.94%                |
| A       | 68  | 40 seg.  | ELECTRIC        | 8.82%           | 19.12%               |
| C       | 76  | 40 seg.  | CO2             | 5.26%           | 0%                   |
| C       | 76  | 40 seg.  | ELECTRIC        | 13.16%          | 23.68%               |
| TOTAL   | 210 | 40 seg.  | CO2             | 2.86%           | 3.33%                |
| TOTAL   | 216 | 40 seg.  | ELECTRIC        | 11.57%          | 21.76%               |

## References

1. RASMUSSEN, A. & ANDERSSON, M. New methods for determination of drip loss in pork muscles. Proceedings of the 42<sup>nd</sup> ICoMST, Lillehammer, Norway, p.286-287, 1996.
2. SILVEIRA, E.T.F. Slaughtering techniques and its effects on pork quality. Doctoral Dissertation, UNICAMP, 1997.
3. STEFFEN HOLST. Return to consciousness in slaughter pigs stunned with CO<sub>2</sub>. Danish Meat Research Institute. www.dmri.dk.

## Acknowledgements

This study was support by the FAPESP (Research Support Foundation of São Paulo, Brazil)

**Table 2.** Statistical results of blood stress indicators and meat quality for carbon dioxide (CO<sub>2</sub>) and electrical pre-slaughter stunning of swine.

| VARIABLE        | Stunning System              |                              | P -level                       | MSE             |
|-----------------|------------------------------|------------------------------|--------------------------------|-----------------|
|                 | Gas (CO <sub>2</sub> )       | Electrical                   |                                |                 |
| CPK (U/L)       | <b>2371.20</b><br>2822 / 331 | <b>1757.96</b><br>2228 / 186 | 0.0240*                        | 6618426         |
| LACTATE mg/dl   | <b>122.21</b><br>46.63 / 331 | <b>146.58</b><br>53.22 / 186 | 4.3x10 <sup>-8</sup> ***       | 2360.181        |
| CORTISOL mcg/dl | <b>11.30</b><br>6.76 / 331   | <b>13.38</b><br>6.27 / 186   | 0.00025***                     | 43.75424        |
| L               | <b>45.61</b><br>5.42 / 149   | <b>43.51</b><br>5.87 / 68    | 0.01072*                       | 30.9266         |
| a*              | <b>0.37</b><br>0.90 / 149    | <b>0.59</b><br>1.15 / 68     | 0.1285                         | 0.965089        |
| b*              | <b>7.12</b><br>1.75 / 149    | <b>5.74</b><br>1.40 / 68     | <b>3.03x10<sup>-8</sup>***</b> | <b>2.715223</b> |
| pH24SM          | <b>5.76</b><br>0.18 / 134    | <b>5.71</b><br>0.17 / 68     | <b>0.0402*</b>                 | <b>0.31566</b>  |
| pH24SC          | <b>6.09</b><br>0.27 / 88     | <b>6.24</b><br>0.18 / 42     | 0.001837***                    | 0.059696        |
| HGP45           | <b>37.92</b><br>6.67 / 374   | <b>33.97</b><br>3.81 / 202   | 2.56x10 <sup>-13</sup>         | 36.6265         |
| HGP24           | <b>87.61</b><br>10.51 / 202  | <b>83.76</b><br>14.23 / 150  | 0.038*                         | 149.71          |
| Drip Loss (%)   | <b>5.23</b><br>1.56 / 72     | <b>5.55</b><br>1.67 / 70     | 0.2374                         | 2.5979          |

**Table 3.** Statistical results of blood stress indicators and meat quality for carbon dioxide (CO<sub>2</sub>) and electrical pre-slaughter stunning of swine.

| VARIABLE        | GENETIC                                  |                                          |                                         | P -level                  | MSE             |
|-----------------|------------------------------------------|------------------------------------------|-----------------------------------------|---------------------------|-----------------|
|                 | A                                        | B                                        | C                                       |                           |                 |
| CPK (U/L)       | <b>1571.29<sup>a</sup></b><br>880 / 132  | <b>2641.69<sup>b</sup></b><br>2722 / 140 | <b>2789.60<sup>b</sup></b><br>4085 / 87 | 0.000689***               | 7212398         |
| LACTATE mg/dl   | <b>118.09<sup>a</sup></b><br>40.99 / 131 | <b>133.61<sup>b</sup></b><br>46.61 / 141 | <b>109.68<sup>a</sup></b><br>48.32 / 87 | 0.000268***               | 2032.051        |
| CORTISOL mcg/dl | <b>9.22<sup>a</sup></b><br>4.89 / 120    | <b>12.11<sup>b</sup></b><br>7.62 / 134   | <b>12.57<sup>b</sup></b><br>6.99 / 85   | 0.000251***               | 43.65973        |
| L               | <b>47.11<sup>a</sup></b><br>5.21 / 72    | <b>45.37<sup>a</sup></b><br>4.89 / 54    | <b>41.46<sup>b</sup></b><br>5.16 / 23   | 0.000040***               | 25.890          |
| a*              | <b>0.28</b><br>0.85 / 72                 | <b>0.34</b><br>0.94 / 54                 | <b>0.76</b><br>0.89 / 23                | 0.07522                   | 0.789972        |
| b*              | <b>7.17<sup>a</sup></b><br>1.93 / 72     | <b>7.42<sup>a</sup></b><br>1.66 / 54     | <b>6.28<sup>b</sup></b><br>0.96 / 23    | <b>0.03058*</b>           | <b>2.951816</b> |
| pH24SM          | <b>5.83<sup>a</sup></b><br>0.17 / 61     | <b>5.74<sup>b</sup></b><br>0.17 / 49     | <b>5.65<sup>b</sup></b><br>0.15 / 24    | <b>0.000039***</b>        | <b>0.28480</b>  |
| pH24SC          | 6.08<br>0.30 / 40                        | <b>6.06</b><br>0.24 / 39                 | <b>6.26</b><br>0.22 / 9                 | 0.11976                   | 0.0705          |
| HGP45           | <b>39.50<sup>a</sup></b><br>6.47 / 119   | <b>39.99<sup>a</sup></b><br>6.37 / 179   | <b>30.59<sup>b</sup></b><br>3.25 / 76   | 9.9X10 <sup>-28</sup> *** | 34.89487        |
| HGP24           | <b>90.72<sup>a</sup></b><br>11.48 / 88   | <b>86.75<sup>ab</sup></b><br>9.65 / 59   | <b>83.54<sup>ac</sup></b><br>8.10 / 55  | 0.000219***               | 102.6025        |
| Drip Loss (%)   | <b>4.74</b><br>1.25 / 31                 | <b>5.52</b><br>1.17 / 21                 | <b>5.68</b><br>2.11                     | 0.062711                  | 2.3007          |

Averages with different letters in the same line differ significantly by the Scheffé test ( $p < 0.05$ ).