Original Article

THE EFFECT OF TRANSPORT DENSITY AND GENDER ON SKIN TEMPERATURE AND CARCASS AND MEAT QUALITY IN PIGS

EFEITO DA DENSIDADE DE TRANSPORTE E DE GÊNERO NA TEMPERATURA DA PELE E QUALIDADE DE CARCAÇA E CARNE EM SUÍNOS

Thuanny Lúcia PEREIRA[1]; Anderson CORASSA[1]; Cláudia Marie KOMIYAMA[1]; Ana Paula Silva TON[1]; Ângelo POLIZEL NETO[1]; Cláudio Vieira de ARAÚJO[1]; Jessika Lucia STUANI[1]; Roque Murilo HONÓRIO[1]

1. Programa de Pós-Graduação em Zootecnia da Universidade Federal de Mato Grosso, UFMT, Campus Universitário de Sinop, Sinop, MT, Brasil. anderson_corassa@ufmt.br

ABSTRACT: Pre-slaughter handling of pigs established properly is very important, not only from the point of view of welfare, but also for the quality of meat. The aim of present research was to evaluate the effect of gender and density of pigs during their transport to the abattoir on the skin temperature and carcass and meat quality. Were used 192 (115.54 ± 6.03 kg) finishing pigs to investigate the effects of gender (barrows and gilts) and transport densities for slaughter (236, 251, and 275 kg/m²) on the skin temperature and carcass and meat quality. Average skin temperature between genders and transport densities at any point of time during pre-slaughter did not differ. Skin temperatures before unloading had the highest average value relative to all other time points, followed by immediately after unloading and remaining the same for the next 2 h. Lowest skin temperature value was registered on pigs at the pre-slaughter time followed by farm and at loading times. Pigs transported with different densities did not show differences for the skin carcass lesions. Meat from pigs transported at 275 kg/m² presented higher frequency of red, soft, exudative (RSE) and lower of red, firm, non-exudative (RFN) classes as compared to those for other densities. Animals transported at 236 and 251 kg/m² did not differ as the frequency of RSE and RFN meat. Skin temperature of pigs oscillate along the pre-slaughter times and the pre-slaughter transport of pigs at 236 and 251 kg/m² generates less frequency classes of faulty pork, although difference in the densities did not have any effect on the skin temperature and skin lesions.

KEYWORDS: Carcass characteristics. Meat characteristics. pH. Pigs. Pre-slaughter. Skin lesions.

INTRODUCTION

Well established pre-slaughter handling of pigs is extremely important not only from the perspective of welfare, but also for meat quality. Among the factors that affect pigs during transport, the density in the livestock truck may have negative influences on the behavioral, endocrine function, blood constituents, and meat quality.

A wide variation exists in the density to be used in the transport of pigs in the pre-slaughter phase. Low and high densities affect the occurrence of losses at slaughter; therefore, most guidelines suggest the use of an average density. Some of the densities used currently include 0.33 m²/animal by the United States (NATIONAL PORK BOARD, 2008), 235 kg/m² or 0.42 m² per pig near 100 kg by the European Union (EC, 2005), and 250 kg/m² by Brazil (CORASSA et al., 2013); however, there are no firm agreement on the precise loading densities that should be reduced at warmer temperatures (SCHWARTZKOPF-GENSWEIN et al., 2012).

Before the slaughter of pigs, intense changes are observed in the behavior of animals, suggestive of the stress considering they are warm-blooded animals with impaired thermoregulatory system due to the presence of keratinized sweat glands and the elevated levels of adipose tissue metabolism; as a result, an ambient temperature be maintained for the well-being of the pigs is recommended (ARAÚJO, 2012).

Despite significant pig production in Brazil, little is known about the losses caused in the pre-slaughter management, especially in regions where the distances from farms to slaughterhouses are large and the temperatures are high (PEREIRA; CORASSA, 2014). This makes it important to fill in the gap created by the lack of specific studies related to density in the transport of pigs as well as their impact on animal welfare and meat quality projects. We hypothesized that different genders and densities to pre-slaughter transport could influence the welfare and carcass and meat quality of pigs. Therefore, we aimed to evaluate the effect of transport density and gender of pigs during pre-slaughter transport on their skin temperature, carcass, and meat quality.

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MATERIAL AND METHODS

The study protocol was consistent with the ethical principles for animal experimentation adopted by the National Council for Animal Experimentation Control and was approved by the Ethics Committee on Animal Use of the Universidade Federal de Mato Grosso (protocol 23108.700436/14-7).

We studied the same pigs as described previously (Pereira et al., 2015). The experiment was conducted in Brazil (coordinates 11°52′23″S, 55°29′54″W and 380 elevation), climate as Aw and B2wA'a' (Köppen's climate classification), and 24.70ºC of average temperature, 1,974 mm of annual rainfall e 1,327 mm of annual potential evapotranspiration (SOUZA et al., 2013).

A randomized design in a 3 × 2 factorial arrangement was employed (236, 251, 275 kg/m² densities x barrows, gilts genders), with 28 replicates per treatment, considering each animal as one experimental unit. A total of 192 finishing pigs with high genetic potential received a diet of 5 $mg.kg^{-1}$ ractopamine until 115.54 ± 6.03 kg, fasting for 12 h, and transportation to a distance of 290 km, of which 14 km unpaved, between 8:27 am and 1:45 pm. Distance was similar to normally used in the production chain (PEREIRA; CORASSA, 2014). Animals were distributed in three densities of transport (236, 251, or 275 kg/m²) and two genders (barrows and gilts). Densities were adjusted by altering the number of pigs transported in the compartments (7, 8, or 9 pigs per compartment for 236, 251, or 275 kg/m², respectively). Only one density was used per shipment, with pigs distributed in the four compartments of the front part of the truck body, barrows were located in the upper right and lower left compartments, and gilts in the upper left and lower right compartments. Two transport events were performed for each pre-slaughter density.

At the slaughterhouse, animals were accommodated in holding pens (0.77 m²/pig) using the same number of animals as for measurements (Table 1) and the same truck (two floors; 4-axle; 30,000-kg capacity; 12 aluminum compartments).

Table 1. Distribution of animals during transport, at holding pens and slaughter according the treatments

Density (kg/m²)	**Gender**	**During transport**			**Holding pens and slaughter**	
		Compartment	**Trip**	**Total**	**Pen**	**Total**
236	Barrows	7	14	28	7	28
	Gilts	7	14	28	7	28
251	Barrows	8	16	32	7	28
	Gilts	8	16	32	7	28
275	Barrows	9	18	36	7	28
	Gilts	9	18	36	7	28
Total				192		168

Unloading in the abattoir was performed similarly for all treatments. After a rest period of 3 hours, pigs had their skin moisturized by spraying water in the waiting and were electrically discharged with 340 V, 50 Hz, 1.0 A for 3 seconds with electrodes on their temples and heart.

Skin temperature was recorded with a digital portable infrared thermometer (Benetch®, accuracy 1.5ºC, fixed emissivity) placed on the loin region of each pig 7 times: at the farm (TF), immediately after loading (TL), immediately before (TbU) and after unloading (TaU), one (T1A) and two hours after unloading (T2A), and pre-slaughter (TPS). Skin temperatures taken at the last four times were recorded on the animals housing in the holding pens of abattoir.

A total of 28 carcasses per treatment were randomly selected for evisceration and sawing, followed by transferring the same to a cold room maintained at 4ºC for further analysis. Slaughter line procedures were performed according to Brazilian Normative Instruction. Lesions on the skin were determined on the left-half carcass of the pigs in the cold chamber at 4ºC, at 24-h postmortem, by following the classification based on 1–5 visual score of Meat Livestock Commission (1985) as (1) no lesion at (5) severely lesion. All scores were given by the same observer.

Swine meat was classified based on the pH measured at 24-h postmortem (pH_{24}) and L* values (VAN HEUGTEN, 2001) in four groups: pale, soft, exudative (PSE, $pH_{24}<5.5$ and L*>50); red, soft, exudative (RSE, $pH_{24}<5.5$ and L*<50); red, firm, non-exudative (RFN, pH_{24} 5.5-6.1 and L*>50), or pale (pH_{24} 5.5-6.1 and L*<50).

The pH was measured using the AK86 portable pH meter (CE RS232, Akso®). The tissue used to measure pH was selected from the 13th and 14th intercostal spaces (*Longissimus thoracis* muscle, LT) from a depth of 3.5 cm.

In addition, at 24-h postmortem, a sample of 100 g of the 6th and 7th intercostal spaces was taken for the color analyses. Meat color parameters were analyzed according to the CIELAB system (CR400; DL65 Minolta colorimeter) by reading the light reflectance in three dimensions as lightness (L*, a*, and b*).

Date of skin temperature were subjected to variance analysis procedures using the SAS software Statistical Analysis System User's Guide (SAS Institute Inc., Cary, NC, USA) with densities and genders as main factors and fixed effects of the days with the means compared by Tukey's test, while the lesion score and pork classification was performed by Kruskal–Wallis analysis. A probability value of $P \leq 0.05$ was considered statistically significant.

RESULTS AND DISCUSSION

Interactions between transport density and gender were not observed for skin temperatures. No significant differences were found in the average values of skin temperature between genders and transport densities at any time point during pre-slaughter (Table 2). However, a considerable effect of the time of pre-slaughter handling on the skin temperature of the pigs was observed (Figure 1).

Table 2. Mean values of skin temperature (º C) of pigs recorded in different moments of pre-slaughter classified by gender and transport density

Skin temperature[1] (º C)	Density (kg/m²)			Gender		Significance[2]			CV
	236	251	275	Barrow	Gilts	Pd	Pg	PdxPg	(%)
Farm	31.59	32.79	31.33	31.80	32.00	0.82	0.36	0.91	4.77
Loading	31.26	31.12	31.77	31.14	31.63	0.98	0.13	0.59	6.48
Before Unloading	36.31	34.98	35.50	35.28	35.91	0.89	0.12	0.46	7.75
After unloading – im.	33.20	32.00	33.60	32.91	32.95	0.13	0.82	0.10	3.41
After unloading– 1 h	33.98	30.38	31.80	32.23	31.87	0.47	0.29	0.77	6.88
After unloading– 2 h	34.12	32.18	31.23	32.76	32.26	0.67	0.08	0.27	6.25
Pre-slaughter	29.17	26.29	26.79	27.46	27.37	0.47	0.68	0.18	6.64

1. Skin temperature recorded at farm (TF), immediately after loading (TL), immediately before (TbU) and after unloading (TaU), one (T1A) and two hours after unloading (T2A) and pre-slaughter (TPS). 2. Pd: significance of density; Pg: significance of gender; Pd×g: significance of density × gender

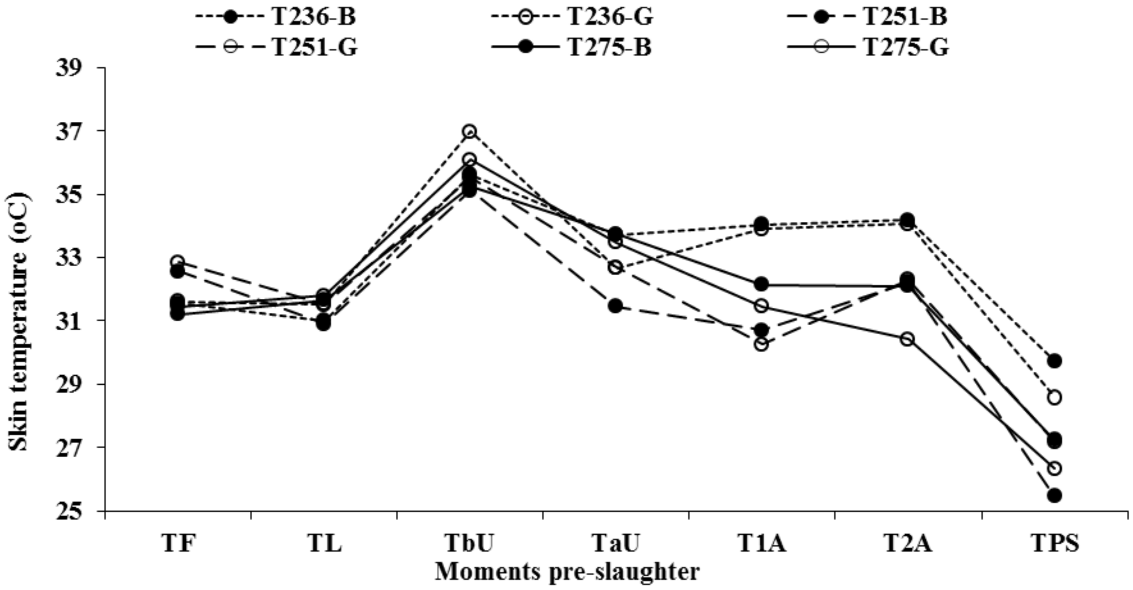
Comparison of the different times of pre-slaughter revealed skin temperature of the animals at TbU had the highest average value ($P \leq 0.05$) relative to at all other times. Then, skin temperature at TaU showed the second highest value ($P \leq 0.05$), which in turn did not differ from the measurement taken at T2A.

Skin temperature values measured at T1A was below TbU and TaU ($P \leq 0.05$), but did not differ ($P \geq 0.05$) from T2A. Skin temperature recorded at TF and at loading were lower than all others time points, but higher than at the pre-slaughter time ($P \geq 0.05$). The lowest skin temperature value was registered on pigs at the pre-slaughter time.

Temperature of the skin of pigs increased dramatically from TF and at the end of the loading in relation to the time of final journey (Figure 1). On the other hand, after the unloading of the animals, it was observed the temperature decreased until it reached its lowest value in the pre-slaughter time.

Stressful situations such as transportation, less floor space, long distance movement during handling, and aggressive handling intensity (RITTER et al., 2009) may lead to increased body temperature in pigs.

The high number of animals or high mass of animals per area could restrict the flow of air between them, reducing heat loss by convection, resulting in higher skin temperatures. However, the results of the present study showed no effects of the transport floor space on the skin temperature at any time point during pre-slaughter, which is consistent with the results of Ritter et al. (2009) for evaluating the rectal temperature of pigs transported at 263 and 333 kg/m². This may be related to the type of vehicle used in the conditions of this study, with livestock container that allow natural or passive ventilation, which enhanced when the vehicles were in motion.



According to the time of recording: farm (TF, 32.00[d]), immediately after loading (TL, 31.50[d]), immediately before (TbU, 35.71[a]) a nd after unloading (TaU, 33.06[b]), one (T1A, 32.18[cd]) and two hours after unloading (T2A, 32.62[bc]) and pre-slaughter (TPS, 27.55[e]). Open circles for gilts and solid circles for barrows. Dotted, dot-and-dash and solid lines for 236, 251 and 275 kg/m² of transport density, respectively. Different superscripts indicate significant differences by Tukey's test (P<0.05).

Figure 1. Mean values of skin temperature (ºC) of pigs recorded at different moments pre-slaughter classified by gender and transport density.

Main determinants of the internal thermal microenvironment in the livestock container are the external climatic conditions, the ventilation regime, internal air flow patterns, and the total heat and moisture production of the animals (NORTON et al., 2013). In addition, the absence of the effect of density during transport on pig skin temperature may also be related to the brief period of time in which the animals were subjected to different densities in which there was no air movement.

Possible differences in the skin temperature between barrows and gilts could be related to the gender–specific interactions. Skin temperature of pigs on the farm and during the loading activities showed no difference because the evaluations were performed in close time intervals, and the temperature only increased at the end of the pre-slaughter period of transport. Similar to previous studies reported no difference between loading until 570 min after departure from the farm increased at unloading (GOUMON et al., 2013).

Similarly, Pilcher et al. (2011) observed the temperatures on the trailer were, on average, least during the loading period at the farm and greatest during the period of waiting at the plant; and Mota Rojas et al. (2006) registered elevated corporal temperatures on the arrival at the slaughterhouse, varying between 38.55 and 39.23°C. However, Sutherland et al. (2009) observed temperature was higher in the trailer during the first 30 min of transport as compared to that in the last 75 min of transport. Other factors such as livestock truck specifications and general conditions of transport of animals can be related to the inconsistency of the present data.

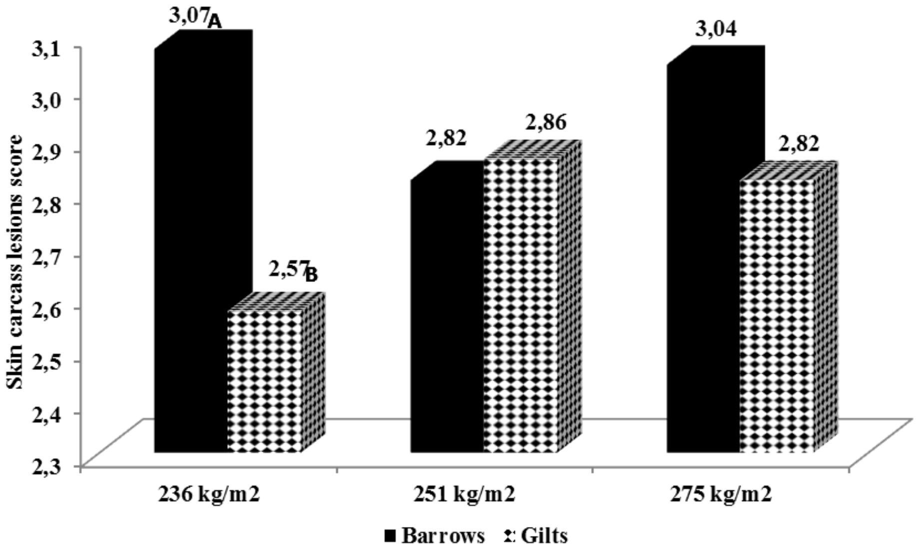
The increase in the swine skin temperature at TbU compared to previously, at farm, and after loading, may be related to the microclimate temperature of that time. Thermal patterns on the skin are related to the skin blood perfusion (HAUVIK; MERCER, 2012), as a consequence of increased heat loss to the environment via heat dissipation. However, the pigs' sweating capacity is limited and their gas exchange may be particularly impaired in high temperature situations. In response to heat stress, the sympathetic vasodilator system can increase the blood flow in the skin, which in turn increases the convective heat transfer from the core to the periphery (WESCHENFELDER et al., 2013). For this reason, the skin temperature is considered as an indirect indicator of the variation in status thermic and performance and the metabolic rate of pigs in response to heat stress, which influences the pig physiology and pork quality (RITTER et al., 2009).

Skin temperature recorded immediately before unloading (TbU) considers that the vehicle is stationary and there is no air flow, as a result the temperature of the front compartments rises, which carries a microclimate inside the livestock container with thermal variations, and thereby influences the welfare of pigs (WESCHENFELDER et al., 2013). In this sense, Mcglone et al., (2014) found temperature of the swine skin surface from the vehicles increased linearly with the increasing outside air temperature. In addition, the air temperature inside and outside of the truck during the journey can influence the loss of quantities of heat and fluids due to panting and sweating, and it is possibly related with enthalpy, which is the heat energy of the air surrounding the animal, dictating the degree of heat loss inside the trailer (VILLARROEL et al., 2011).

After unloading of the animals, a tendency of reduction of the skin temperature with time was observed, possibly due to the accommodation of the animals in stalls, whose density, water availability, and the spraying of water on pigs offsetted the higher temperature. Araújo (2012) noted the use of spray at the beginning and end of the 3-h rest period provided adequate rest to the pigs and allowed better environmental adaptation, thereby reducing the surface temperatures of the animals.

In general, skin temperatures of pigs reported in this study were greater than those of pigs used by Araújo (2012), who reported an average of 23.45–28.47°C at the surface temperature of the loin region. This difference can be attributed to the different climatic conditions of each study region in terms of higher body temperatures or higher ambient temperature.

Pigs transported at different densities did not show differences in their skin carcass lesions (Figure 2). Barrows transported at 236 kg/m² showed a higher value of carcass lesion score than gilts ($P \leq 0.05$); moreover, there was no effect of gender on others densities.



According to gender: crosshatched bars for gilts and solid bars for barrows.

Figure 2. Skin carcass lesions score on the left half-carcass of pigs after 24 h *postmortem* classified by gender and transport density

A higher density at transport of pigs from the farm to the slaughterhouses may increase the risk of aggression and thereby skin damage; moreover, this was not observed in this study, which is consistent with the observation of a previous study (GUISE et al., 1998) in which the stocking density did not affect the meat quality nor caused skin damage. Similarly, Ritter et al. (2006) reported increasing floor space during transport equivalent from 256 to 208 kg/m² did not affect the incidence of non-ambulatory, injured pigs at the plant.

In contrast, Barton Gade and Christensen (1998) evaluated stocking densities of 200–285 kg/m² and observed that 238 kg/m² density resulted in more pigs with unacceptable skin damage in all areas of the carcass as compared to other stocking densities. Also, at 256 kg/m² density, higher frequency of pigs with unacceptable skin damage (only in the shoulder) were noted, supporting the risk of skin damage increases when a space more than 285 kg/m² is provided during transport. The increase in skin lesions on pork carcass is related to the pig behavior during transport such as trampling and/or aggressive encounters; moreover, it varies with pigs as some are more aggressive than others, which in turn is related to their cortisol levels (WARRISS et al., 1998)

Failure to observe the effect of density transport on lesions score may be related to other influencing factors. Skin lesions on the carcass is caused by handling on the farm, mixing, fasting, handling at loading and unloading, transport to the slaughterhouse, lairage and repercussions on animal welfare, meat quality, and economical value. The presence of marks on the carcass is often considered as a secondary problem may be solved by removal of the blemished part. However, the related effects on meat quality variation must be considered. Recently, Brandt and Dall Aaslyng (2015) reviewed that the main stages on the day of slaughter at which skin damage occurs in finishing pigs is in the pick-up facilities, although this describes the sum of occurrences throughout the day of slaughter in terms of skin damage that has been assessed and documented.

Carcass lesions scores recorded in the density of 236 kg/m² in barrows may be due to the greater agitation and restlessness as compared to gilts. The scores were similar to that of Vanheukelom et al. (2012), who reported 60% of gilts had a lesions score of 1 and 40% had a score of 2 in the middle region of the carcass as compared to 38.6 and 50% for barrows, respectively. Lesions score of 3 and 4 were not observed in gilts, while 10% of males had a score of 3 and 1.4% had a score of 4. The difference in skin lesions in pork carcasses may be related to the level of aggression linked to their gender. It can be inferred aggression leads to skin damage, which indicates that, although aggression is a normal behavior in pigs, but it is still stressful. Thus, this type of lesion may also be related to the large amount of space in the vehicle and the tendency of animals to display more movements due to vibration, in addition to the greater impact in the compartments and the lack of stability among pigs.

Interactions between transport density and gender were not observed for the frequency of pork meat classes studied as they were not influenced by gender (Table 3).

Table 3. Classes frequency of pork quality from the muscle *Longissimus thoracis* according to gender and transport density

Classes (%)[1]	Density (kg/m²) 236	251	275	Gender Barrow	Gilts	Significance[2] Pd	Pg	PdxPg	CV (%)
PSE	16.07	16.04	14.29	16.67	14.26	0.87	0.65	0.34	12.6
RSE	8.93[b]	3.57[b]	58.92[a]	25.00	22.62	0.03	0.67	0.50	19.8
RFN	50.00[a]	53.46[a]	21.43[b]	41.67	41.60	0.04	0.90	0.56	17.7
Pale	25.00	26.93	5.36	16.66	21.52	0.09	0.15	0.22	19.2

[1] PSE: pale, soft, exudative; RSE: red, soft, exudative; RFN: red, firm, non-exudative
Different superscripts within the same row indicate significant differences by Kruskal-Wallis's test (p<0.05)

Meat from pigs transported at 275 kg/m² presented higher frequency of RSE and lower of RFN classes as compared to the other densities ($P \leq 0.05$). Animals transported at 236 and 251 kg/m² did not differ ($P \geq 0.05$) in their frequencies of RSE and RFN meat. PSE and pale pork occurrence was not influenced ($P \geq 0.05$) by the densities during the transport of pigs in the pre-slaughter management. Color, firmness, and water-retention capacity changes featuring meat outside the ideal pattern (RFN) showed considerable frequencies in this study, in the order of 50.0, 46.5, and 78.6% at densities of 236, 251, and 275kg/m² or 58.3 and 58.4% in the barrow sand gilts, respectively.

Highest density (275 kg/m²) showed the negative effect that excessive pig quantity may have on the occurrence of non-ideal pork in terms of low frequency of RFN and high frequency of RSE pork. The RSE pork can be considered as intermediate PSE, but with normal coloration and without reaching the high protein denaturation, evaluated from the pH24 in the carcass. This non-compliance as RSE could be reported due to muscle fiber composition as higher proportion of IIb fiber, characterized by fast glucolytic metabolism and explained by the low pH45 and high drip loss (WESCHENFELDER et al., 2013).

In general, at the excessive pig density (275 kg/m²), the animals showed a pH45 that may characterize a situation of discomfort in the vehicle, thus having an effect on the meat quality. According to the characterization of this study, this effect is indirectly related to the number of animals in each box. Gajana et al. (2013) observed highest risks of PSE occurrences when the space allowance during transportation was increased by an equivalent of 250 kg/m² and the lowest risks of occurrences at 285 kg/m² allowance of during transportation.

Therefore, the results seemed to indicate a low probability of production of non-compliance pork when the density is decreased from 275 to 251 or 236 kg/m². However, no effect of density on pH24 was recorded by Warriss et al. (1998). Differences in the responses between studies may be related to the interaction density transport during the journey. Gajana et al. (2013) observed an increased incidence of PSE pork when the transportation time was increased and stocking density was reduced.

High frequencies of non-compliance as PSE, RSE, and pale pork observed in this study in all densities and genders, featuring a production system with difficulties in mitigating the factors generated less than ideal products. PSE pork is indicative of a short-lived stress, interference of stress hormones, influence on the muscle metabolism, enhanced depletion of the muscle glycogen, and deposition of lactic acid in the muscles. In general, the high frequency of PSE pork may be related to the local conditions, especially climate. In Brazil, the incidence of PSE pork is still high, which can be attributed to the poor pre-slaughter handling conditions and genetic component of the animals since the occurrence of halothane gene was high in pig herds (PARANHOS DA COSTA et al., 2012). Moreover, others researches report expressive PSE frequency of 24 at 68% (GAJANA et al., 2013).

In this study, the gender did not have any effect on the pork quality traits. Vanheukelom et al. (2012) observed the content of this myoglobin in meat tissues was independent of the sexual category, which is why there difference in color pattern was negligible.

The recommended densities to ensure welfare of pigs continue to remain debatable to prevent the occurrence of skin lesions by handling, density or fights, and especially for obtaining good meat quality. The density should be adjusted based on the local transport conditions.

CONCLUSIONS

Transport density it's an important factor that can affect meat quality, as was observed in this study, an excessive number of pigs at a density of 275 kg/m² generates non-ideal pork, while animals transported at 236 or 251 kg/m² generates less carcass damage although no effect was observed on the skin temperature and skin lesions.

Comparison at different moments of pre-slaughter revealed a highest skin temperature on the animals immediately before unloading, this, under the environmental conditions of this experiment. Barrows and gilts showed the same frequency classes responses of pork quality and skin temperature on the pre-slaughter management. Further research is needed to evaluate all the factors that can influence skin temperature of pigs and the occurrence of skin lesions in Brazilian conditions, thus to reduce the frequency of promoted non-ideal pork at the pre-slaughter management.

RESUMO: O manejo pré-abate estabelecido adequadamente é importante, não apenas do ponto de vista de bem-estar, mas também para qualidade da carne. O objetivo com o presente estudo foi avaliar o efeito do gênero e da densidade de transporte de suínos para o abatedouro sobre a temperatura da pele, qualidade de carcaça e carne de suínos. Foram utilizados 192 (115,54 ± 6,03 kg) suínos em terminação para avaliar os efeitos de gênero (machos castrados e fêmeas) e densidades de transporte para abate (236, 251, e 275 kg / m²) sobre a temperatura da pele e qualidade de carcaça e carne de suínos. Os valores médios de temperatura da pele entre os gêneros e densidades de transporte não diferiram no pré-abate. A temperatura da pele dos animais antes do descarregamento foi maior, seguidos pelo momento imediatamente após a descarga e mantendo o mesmo para as próximas duas horas. O menor valor de temperatura da pele foi registrado em suínos no momento pré-abate seguido pelos momentos à granja e ao carregamento. Os suínos transportados com diferentes densidades não apresentaram diferenças para as lesões na carcaça. Carne de suínos transportados a 275 kg / m² apresentaram maior frequência de carne vermelha, flácida e exsudativa (RSE) e menores de carne vermelha, firme e não-exsudativa (RFN) em comparação com outras densidades. Os animais transportados à 236 e 251 kg/m² não diferem quanto a frequência de carne RSE e RFN. A temperatura de pele de suínos oscila ao longo dos momentos pré-abate, e transporte de suínos pré-abate com 236 e 251 kg/m² geram menor frequência de classes anormais de carne, embora diferenças nas densidades não tiveram efeitos sobre a temperatura da pele e lesões de pele.

PALAVRAS-CHAVE: Características de carcaça. Características de carne. pH. Suínos. Pré-abate. Lesões da pele.

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