

**Evaluation of pH in swine carcasses regarding on the trasport distance of the animals: a case study**

**Avaliação do pH em carcaças suínas em função da distância de transporte dos animais: um estudo de caso**

**Evaluación del pH em canales de cerdo em función de la distancia de transporte de los animales: um estúdio de caso**

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## **Abstract**

The PSE (Pale, Soft and Exudative) swine meat is an anomaly that produces great economic losses in the swine industry and products because proteins lose their functionality, affecting the ability of water retention, binding, and emulsification of meat. Due to the importance of quality control of carcasses, the determination of the pH parameter is necessary to perform the classification of the product in: normal; PSE; and DFD (Dark, Firm, and Dry). In this sense, the purpose of the work was to perform the evaluation of pH values after 45 minutes of bleeding (pH<sub>45</sub>) and function of the distance from farms to a slaughterhouse and calculate the indicator of Meat PSE in swine carcasses. The experiment was carried out in a large plant, under the supervision of the Federal Inspection Service (SIF). A total of 725 carcasses were used, separated into lots and the transport distance from the farms to the slaughterhouse ranged from 25 to 427 km. For the evaluation of the incidence of PSE, pH<sub>45</sub> was measured by a direct method, and the management of pre-slaughter animals was standardized for all lots, except for rest time. The animals transported for shorter distances (25 and 65 km) presented 11% indicative of PSE meat, a fact that shows that the stress response is higher when the animals are subjected to short transport distances compared to longer distances (320, 340, and 427 km).

**Keywords:** Quality; Animal welfare; Pig meat; PSE.

## **Resumo**

A carne suína PSE (*Pale, Soft and Exudative*) é uma anomalia que gera grandes perdas econômicas na indústria frigorífica e de produtos cárneos pois as proteínas perdem sua funcionalidade, afetando a capacidade de retenção de água, de ligação e de emulsificação das carnes. Devido à importância do controle de qualidade da carne suína, a determinação do parâmetro pH é necessária para realizar a classificação em normal, PSE e DFD (*Dark, Firm and Dry*) do produto. Nesse sentido, a proposta do trabalho foi executar a avaliação dos valores de pH após 45 minutos da sangria (pH<sub>45</sub>) em função da distância das granjas ao abatedouro e calcular o indicativo de carne PSE em carcaças suínas. O experimento foi

realizado em um frigorífico de grande porte, sob supervisão do Serviço de Inspeção Federal (SIF). Foram utilizadas 725 carcaças, separadas em lotes e a distância de transporte das granjas ao frigorífico variaram entre 25 e 427 km. Para a avaliação da incidência de PSE, foi mensurado o pH<sub>45</sub>, por método direto sendo o manejo dos animais pré-abate padronizado para todos os lotes, com exceção do tempo de descanso. Os animais transportados por menores distâncias (25 e 65 km) apresentaram 11% de indicativo de carne PSE, fato que evidencia que a resposta ao estresse é maior quando os animais são submetidos a curtas distâncias de transporte em comparação com distâncias maiores (320, 340 e 427 km).

**Palavras-chave:** Qualidade; Bem-estar animal; Carne suína; PSE.

### Resumen

La carne de cerdo PSE (*Pálido, Suave y Exudativo*) es una anomalía que genera grandes pérdidas económicas en la industria de la refrigeración y los productos cárnicos porque las proteínas pierden su funcionalidad, afectando la capacidad de retención de agua, unión y emulsión de la carne. (Debido a la importancia del control de calidad de la carne de cerdo, la determinación del parámetro de pH es necesaria para realizar la clasificación en normal, PSE y DFD (*Oscuro, Firme y Seco*) del producto. En este sentido, el objetivo del trabajo fue ejecutar la evaluación de los valores de pH después de 45 minutos de sangrado (pH<sub>45</sub>) y la función de la distancia de las granjas al matadero y calcular el indicador de PSE de carne en canales porcinos. El experimento se llevó a cabo en una gran fábrica, bajo la supervisión del Servicio Federal de Inspección (SIF). Se utilizaron un total de 725 canales, separados en lotes y la distancia de transporte desde las granjas hasta el frigorífico osciló entre 25 y 427 km. Para la evaluación de la incidencia de la PSE, el pH<sub>45</sub> se midió por método directo, y la gestión de los animales pre-sacrificios se estandarizó para todos los lotes, excepto para el tiempo de descanso. Los animales transportados para distancias más cortas (25 y 65 km) presentaron un 11% de indicativo de la carne de PSE, un hecho que muestra que la respuesta al estrés es mayor cuando los animales están sometidos a distancias de transporte cortas en comparación con distancias más largas (320, 340 y 427 km).

**Palabras clave:** Calidad; Bienestar de los animales; Carne de cerdo; PSE.

### 1. Introduction

Swine meat needs greater visibility in the consumer market and, for this, it is necessary to have its quality controlled to meet the expectations of consumers. The quality of

pork meat is classified according to the pH, and according to the value obtained, the meat is called as normal; PSE (Pale, Soft and Exudative); or DFD (Dark, Firm and Dry) (Menezes Júnior, 2019).

The quality of pork has a strong relationship with the management of pre-slaughter, if this phase provides the animal with stress and suffering, there will be a negative mark on it, in which is possible to observe differences in taste, texture, and appearance. Water retention and pH will consequently change, representing a financial loss concerning quality being below expected (Santos, 2011).

The swine carcass shall be considered normal when the initial pH has a value of 5.8 or more and the final pH is less than 6.0. The meat will be classified as PSE when the initial pH shows a value of less than 5.8 and the final pH less than or equal to 5.6; and will be indicated as DFD, when the final pH has a value greater than 6.0. The initial pH is collected 45 minutes after the slaughter of the animal and the final pH is measured after 24 hours in cooling (Bridi & Abércio, 2009).

The way of greater simplicity and ease to detect if there is any problem with the quality of meat used in industrialization is through pH determination, and a pH lower than expected means an exaggerated presence of lactic acid in the meat due to short-term stress and, consequently, meat with a pH above the expected value means the lack of lactic acid (ABCS, 2014).

The objective of this study was to evaluate the pH values after 45 minutes as a function of the distance from the farms to the slaughterhouse and to calculate the PSE meat indicator according to the pH values.

## **2. Materials and Methods**

The experiment was carried out in a large swine plant with a daily slaughter capacity of 2.000 pigs, under the Federal Inspection Service – SIF (Patos de Minas, MG, Brazil).

### ***2.1 Obtention of animals***

The selected animals from the same genetic lineage were slaughtered with an average weight of 115 kg, following the slaughter rules according to Ordinance No. 711 of November 1, 1995, of the Ministry of Agriculture, Livestock and Supply - MAPA.

A total of 725 carcasses were used, separated into lots and the transport distance from the farms to the refrigerator ranged from 25 to 427 km. Thus, the lots were identified and sampled according to Table 1.

**Table 1.** Sampling of lots of animals.

Lot	Distance Traveled (Km)	Number of Samples
A	320	100
B	340	25
C	25 - 65	500
D	427	100

Source: Research Data.

For distances of 320, 340, and 427 km, the suppliers were the same. For the 25 to 65 km, there were 4 different suppliers.

## 2.2 pH analysis

For the assessment of the incidence of PSE, the pH was measured at 45 minutes ( $\text{pH}_{45}$ ) after bleeding, by a direct method, using a portable pHmeter (AK103, Akso), which was introduced in the center of the *longissimus dorsi muscle* of the right half of the carcass, standardized for all carcasses (Bressan, Prado, Pérez, Lemos, & Bonagurio, 2001).

According to Gomide, Ramos & Fontes (2013), carcasses with  $\text{pH}_{45} < 5.8$  are classified as PSE and those with  $\text{pH}_{45} > 5.8$  as normal. The management of pre-slaughter animals was standardized for all lots, except for rest time.

## 2.3 Statistical analysis

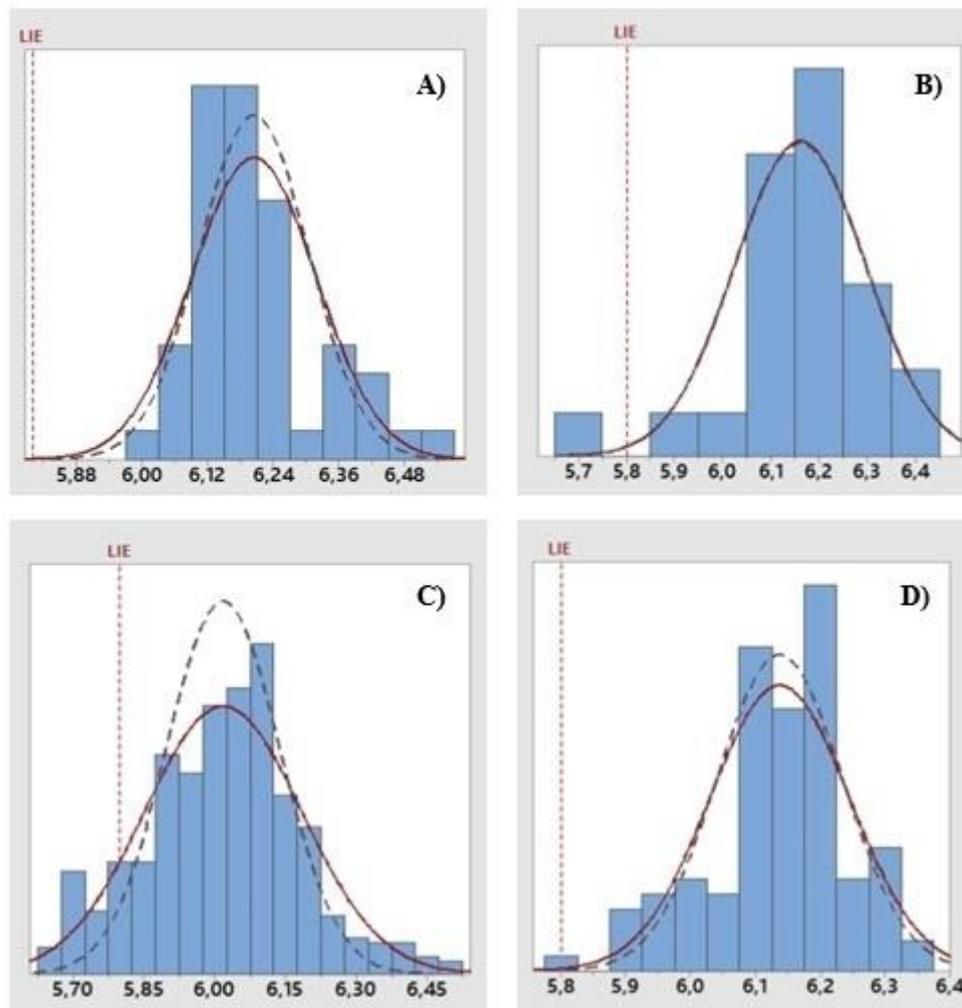
The data obtained from the measurement of ( $\text{pH}_{45}$ ) were treated in the statistical software *Minitab*, the means and standard deviation were evaluated and the percentage of carcasses that presented pH below 5.8 for each distance analyzed.

## 3. Results and Discussion

The occurrence of PSE meat is due to genetics (intrinsic factors) or environmental factors (extrinsic factors), causing pre-slaughter stress, this is the main depletion factor of

muscle glycogen reserves. It is noteworthy that pH is the most important parameter to predict the final quality of pork, as it directly or indirectly influences the properties and various quality characteristics of pork such as color, softness, taste, water retention capacity, and conservation (BRIDI & SILVA, 2006). Figure 1 shows the pH graphs of the carcasses of the animals as a function of the transport distances.

**Figure 1.** Graphics for the pH determination for swine carcasses among distances of 320 (A), 340 (B), 25-65 (C) and 427 Km (D).



Source: Authors.

None of the carcasses from the farm located 320 km from the plant presented pH values below 5.8. Considering the distance of 340 km, 4% of the animals presented indicative characteristics of PSE. For distances of 25-65 km, 11% of the carcasses presented values below the specified, which represents indicative of PSE meat as reported by Pérez et al.

(2002). Only 1% of the carcasses of the distance of 427 km treatment presented pH with inadequacy.

Ochove et al. (2010) found that the shorter distance traveled caused higher cortisol levels, which produced acute stress, while the greater distance caused greater losses due to chronic stress and mortality. Pérez et al. (2002) evaluated pigs transported in two times (15min and 3h) and found that the shortest time presented lower pH values and high levels of cortisol and lactate, to demonstrate that the longer time, despite exposing the animals to longer periods in stressful conditions, also provides better adaptation, which makes them less influenced to the aggressions of the environment.

Fernandez & Tornberg (1991) observed some difficulty in concluding the true effect of transport time on meat quality due to the different results obtained from different authors, which suggests the possibility of the interaction of several factors. Gomide, Ramos & Fontes (2006) reported that short-term pre-slaughter stress, originating from the stages of slaughterhouse management, being reception, waiting, and conducting slaughter, is potentially associated with PSE pork. In the present study, although there was no replication of the experiment, the other factors that could interfere in the results were controlled by subjecting the animals to similar conditions of transport, coming from the same genetic lineage and slaughtering with an average weight of 115 kg.

PSE meat is an anomaly that generates great economic losses in the plant and meat products because as a result of the denaturation occurred in the meat, proteins lose their functionality, affecting the capacity of water retention, binding, and emulsification of meats (Kim, Warner, & Rosenvold, 2014). However, the lower pH found in PSE meat contributes to its conservation, from the microbiological point of view, and increased shelf life, however, makes this meat more susceptible to lipid oxidation (O'Neill et al., 2003).

Thus, it is necessary to control in obtaining swine meat, but there is no international standardization for the effective identification of anomalies such as PSE meat.

#### **4. Conclusion**

The short distances (25-65 km) of transport of animals from the farm to the slaughterhouse caused the highest indication of PSE meat when compared to the other ones (320, 340, and 427 km) considering the pH after 45 minutes of bleeding.

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