Available online at www.worldscientificnews.com

World Scientific News

WSN 78 (2017) 6-13 EISSN 2392-2192

The impact of transport on the quality of pig meat

Urszula Ostaszewska

Siedlce University of Natural Sciences and Humanities, Siedlce, Poland

E-mail address: uostaszewska@onet.pl

ABSTRACT

The purpose of this paper was to present the problem of transport of pigs, taking into account legal requirements of transport, Carriage and changes occurring in the physiological state of the transported pigs as well as the quality of the pig meat obtained from them. Transport of pigs is a significant element in the production cycle of high quality meat. Often, serious economic losses are caused by improper transportation, poor animal welfare and the exposure of many stressors over a short period of time. At present the conditions of animal transport in Poland are regulated by "Regulation (EC) No 1/2005 of 22 December 2004 on the protection of animals during transport and related activities."

Keywords: quality, pork, transport

1. INTRODUCTION

Meat quality is an ensemble of all qualities and properties of meat raw material, influencing its high sensory, technological, utility and culinary qualities (Andersen 2000, p. 17). High quality meat should be characterized by the absence of unsafe micro-organisms, chemicals, physical impurities, qualitative flaws and high nutritional value (Pisula, Pośpiech 2011, p. 231). The fragility, juiciness, desirability and proper taste and smell of meat are the most important qualities of pork for the consumer (Sienkiewicz, Lewandowska 2012, pp. 261-272). The high quality of pork is influenced by both genetic factors in 25-45% (Koćwin-Podsiadła et al 2001, p. 11-18) and environmental in 55-75% (Koćwin-Podsiadła 1993, p. 1-

112). Genetic factors include race and genotype of an animal. On the other hand, environmental factors such as nutrition, transport, ante-mortem, slaughter and the rate of chilling after slaughter (Sionek, Przybylski 2015, pp. 35-48). When loading, transporting and unloading animals, it is most likely to decrease the quality of the raw material through the occurrence of mechanical injuries of the skin, limb fractures and the formation of defective meat PSE and DFD (Pisula, Pośpiech 2011, p. 52).

2. LEGAL REQUIREMENTS FOR THE TRANSPORT OF PIGS

Requirements for the transport of live animals are contained in "Regulation (EC) No 1/2005 of 22 December 2004 on the protection of animals during transport and related activities." The basic requirements to be ensured during the transport of animals according to the Regulation are: For transport, practices used during the pre-slaughter trade, suitable animal area in means of transport and their construction. In accordance with Regulation (EC) No 1/2005 regarding the technical requirements for live animals, means of transport should: avoid mechanical exposures of the skin by animals, enable animal safety, protect animals from the weather, be easy to clean and disinfect, be equipped with An anti-slip floor that limits urine and faecal leakage, allowing access in case of control. The legal regulations in force in Poland also determine the qualifications of drivers. Commercial drivers who carry animals over 65 km are required to hold a license. It is valid for 5 years and is registered in an electronic database. In order to obtain it, the carrier must show that he has the appropriate number of personnel, equipment and operating procedures. On the other hand, persons who transport their animals at a distance of up to 50 km are exempted from the permit but must provide animals with safety, protection against adverse weather conditions and appropriate means of transport for animals. If the transport takes more than 8 hours, the applicant must submit to the relevant state authority: the professional qualification certificates for drivers and accompanying persons, the vehicle approval certificate, the vehicle traffic monitoring and recording information, and emergency plans. If you plan to travel abroad, the driver must have a suitable travel plan prepared by the transport organizer in accordance with the standard model and include information on the identification of the animals, the persons responsible for them, the place of departure and destination and the checks carried out during transport. Every driver transporting live animals should know how to deal with animals (Journal of Laws 2004 No. 100 item 1012).

3. PRINCIPLES AND CONDITIONS OF TRANSPORT OF PIGS

The transport of live animals is subject to detailed rules. Swine should be charged so that it is free to stand and lie in a natural position. It is also important to ensure that during transportation a suitable loading surface for pigs, depending on body weight, eg adult fattening it is about $1m^2$ / piece. For each piece should be the following floor area:

- pigs weighing up to 25 kg - area from 0.20 to 0.24 m^2,
- pigs weighing 25 kg to 80 kg - 0,53 to 0,60 m^2,
- pigs weighing from 80 kg to 130 kg - 0.66 to 0.83 m^2,

- pigs weighing from 130 kg to 200 kg - 1.00 m^2,

- pigs weighing over 200 kg - 1.5 m^2. (Journal of Laws No. 69/90, Art. 16)

It is worth noting that with the specific conditions of pigs transported the floor surface can be increased by 20% (Cierach, Idaszewska 2014, pp. 21-25). During loading we recommend: limiting the combination of pigs from different pens to reduce the occurrence of aggression among animals, limiting the use of electric goats, loading small animals (2-6 individuals), using 1 m wide passageways, Individuals next to each other (Journal of Laws 2004 No. 100 item 1012). The tilt angle of the loading ramps should be 20-25º. This ramp slope does not prolong the loading time, does not tire the animals as well as the animals do not show aversion to the trailer (Lee, Choi 1999, pp. 244-252). Pods should have mounted hoof stops to facilitate the movement of animals and be constructed of non-skid materials (Gaworski 2013 s. 40-46).

4. MEANS OF TRANSPORT FOR THE TRANSPORT OF PIGS

Truck transport is the most popular means of transport for animal transport (Pisula, Pośpiech 2011, p. 52). Cars should provide protection against adverse weather conditions. Animal transport vehicles should be equipped with forced ventilation systems, temperature recording systems and animal watering systems. Since 2009, vehicles carrying animals more than 8 hours must be equipped with satellite navigation equipment (Journal of Laws 2004 No. 100 item 1012). In order to protect pigs from the adverse climatic conditions, an important element is the efficient ventilation and heating system whose temperature range is regulated by the rules of road transport of live animals (Cierach, Idaszewska 2014, 21-25). The air temperature in the middle of the semi-trailer should be between 5 and 30 °C with a permissible difference of +/- 5 °C (Journal of Laws 2004 No. 100 item 1012). Placing feeders at different heights allows access to water of pigs of all ages. The size of the ventilation openings should be 20% of the floor area and 30% of the maximum floor area of the vehicle (Prost 2006). The recommended duration of the pigs is 8 hours, but in exceptional cases with additional requirements it can include 24 hours standby.

Cars carrying pigs are made up of a tractor and a semi-trailer or a car with a trailer. In order to reduce transport costs, pigs are transported using large trailers, usually consisting of three decks. In newer vehicles for the transport of pigs, improvements are being made to improve the welfare of animals during transport, ie moving bulkheads, the possibility of spraying animals with water. The loading surface of the semitrailer for the transport of pigs consists of three decks. Only the bottom is fixed.

The back of the body is a trap with folding side barriers and an internal door system. It is used when loading and unloading animals. Swine trailers have lockable sectors to distribute the animals evenly on the surface of the vehicle during transportation, thus reducing the accumulation of animals in one place. In Poland, the Road Transport Inspection and the State Veterinary Inspection supervise appropriate transport and animal welfare conditions (Tereshkiewicz 2012, s. 2279). The use of modern swine transporters improves animal welfare and reduces the number of injuries and injuries to animals.

Table 1. Livestock welfare conditions

Welfare requirements	Conditions necessary to meet welfare requirements
Free from hunger and thirst	By providing fresh water and feed covering growth, health and food needs
Free from discomfort	By securing a comfortable rest area, shelter opportunities and optimum environmental conditions
Free from pain, injury and illness	By providing prevention, prevention, rapid diagnosis and effective treatment
Free from fear and stress	By eliminating stressors
Capable of expressing a normal behavior	By providing adequate living space and social composition in the group

Source: Kołacz R.: Wymogi w zakresie transportu, Trzoda Chlewna 11, 95, 2003.

Tabela 2. Indicators of low and high welfare

Low level of wellbeing	High level of wellbeing
- reduced level of adaptability to stressful situations - limitations in the manifestation of natural behavioral responses - Behavioral pathologies (stereotypes) - reduction of growth and reproductive capacity - injury (environmental resilience) - immunosuppression -diseases	- the manifestation of various forms of normal behavior - Maintain normal physiological ratios - Maintaining norms of behavioral patterns

Source: Kołacz R.: Wymogi w zakresie transportu, Trzoda Chlewna 11, 95, 2003.

5. REDUCE THE VALUE OF MEAT DURING TRANSPORT

The negative effects of transport of pigs include: mechanical injuries of the skin, wounds, bloody myelomas in the muscle tissue, fractures and bone fractures (Pisula, Pośpy 2011, p. 57). Studies show that more than 60% of fattening pigs transported to slaughter are affected by skin injuries caused during transport (Pisula, Pośpy 2011, p. 61). The social stress that arises as a result of mixing litters during transport causes a fight for the hierarchy between the pigs. The effect on the amount of injury in fattening pigs is: technical condition and vehicle equipment, transport time and distance (Cierach, Idaszewska 2014, p. 23).

6. STRESS DURING TRANSPORT

Stress is defined as the non-specific reaction of the body to all demands (Selye, 1978). Occurs when the impact of the environment exceeds the self-regulatory capacity of the body. The individual characteristics of a given individual are the main determinants of stress responses. Stress leads to high levels of stress hormones (corticosteroids) in the blood, which results in weakening of the immune system and the extinction of the body (Maroc-Pieńkowska et al., 2014, pp. 36-42). If stress factors are present in a small amount, then the pig organ is trying to adapt and adapt adaptation mechanisms (Mroczek 2013, p. 184). Swine is a species of animal susceptible to adverse environmental conditions and stimuli. This is due to the characteristic features of the blood system (small heart mass, short duration of the resting phase of the heart) of the pigs. In addition, the blood of the pigs has a small mass compared to the weight of the whole body. The lack of sweat glands in pigs determines their greater susceptibility to thermal stress (Gregory 2008, s. 2-11).

The highest sensitivity to stress is characterized by high-performance pigs, due to lower adaptability to variable temperature conditions. During transport of pigs there may also be social stress and transport stress. Social stress occurs when it comes between individuals to fight to establish hierarchies encountered during transport, for example in the case of litter confusion. Transport stress is manifested by weight loss of skin lesions and above all the occurrence of qualitative changes in meat (Cierach, Idaszewska 2014, s.23-24).Excessive temperature, noise, beatings, overexploitation, change in light conditions, litter mixing, hunger and thirst (Sionek, Przybylski 2015, pp. 35-48). Stress overload leads to pigs Heart arrhythmia, elevated temperature, increased breathing rate, limb stiffness and immobility. The effects of transport stress are: falls, weight loss, mechanical skin injuries and quality defects of meat (Cierach, Idaszewska 2014, p. 23-24). The DFD meat defect arises when pigs are exposed to stress for a long period of time. On the other hand, the defect of PSE when stress is short-lived (Pisula, Pośpy 2011, p. 231-235). In order to reduce stress in pigs it is recommended to transport animals at night or morning when the air temperature is lower, thereby reducing the negative impact of high temperature on the animal body and exposure to sunlight. The pig production cycle usually takes place in enclosed buildings, so reducing exposure to sunlight reduces the level of stress in animals. The ventilation, air conditioning and sprinkler systems (Cierach, Idaszewska 2014, p.21-25) are also used to reduce the temperature of the air and thereby limit the occurrence of thermal stress in the vehicle.

7. FALLS CAUSED BY STRESS DURING TRANSPORT

High animal mortality during transport is a sign of poor welfare and economic loss for the breeder and the processing plant. It is estimated that in Europe about 0.03% of animals die during transport (<8h), of which 70% fall in the car and another 30% during landing. In Poland, the fall of pigs in transport is about 0.06% (Tereszkiewicz et al., 2011, p. The mortality rate of fattening pigs has a huge impact: car construction, animal density and animal handling during loading and unloading (Temple et al., 2014). Also, the genetic factors of the individual have a significant effect on mortality during transport. Reducing the frequency of the halon sensitivity gene leads to reduced transport losses. The halothane sensitivity gene is responsible for coding the muscular proteins of the rianodine receptor, which participates in

the control of calcium transport from the sarcoplasmic mesh to the cytoplasm of the muscle cells (Temple et al., 2014). The main cause of the mortality of pigs, conditioned by both environmental factors and animal genotype, is malignant hypothermia. In animals that have a halothane sensitivity gene, they can contribute to the development of hyperthermia (Temple et al., 2014).

8. THE IMPACT OF TRANSPORT OF PIGS ON THE QUALITY OF PIG MEAT

Transport also has an effect on glycogen content in animal muscles. The content of glycogen in meat determines its quality and purpose in the processing of pork meat. Glycogen is a backbone found in the liver and muscle of animals (Przybylski et al. 2006, p. 257-262). PSE and DFD are the two main types of quality defects in pork meat. Both depend on the pH of the meat and glycogen content in the muscle that will be converted to lactic acid during slaughter. PSE (pale, solft, exudative, soft, watery) meat is characterized by a faster than usual decrease in pH below 5. This is due to the intense, brief stress response to which animals are exposed immediately prior to slaughter (inappropriate handling With animals during unloading, mixing of unknown individuals) (Pisula, Pośpiech 2011, s. 244-248). From a biochemical point of view, The impact of transport of pigs on the quality of pig meat Transport also has an effect on glycogen content in animal muscles.

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Protein denaturation is then very fast, resulting in the meat being soft, light with excessive exudate. PSE meat is less valuable in terms of culinary value to the consumer. From a practical point of view, the PSE defect is more profitable for processing (Pisula, Pośpiech 2011, s. 244-248). DFD (dark, firm, dry, dark, hard, dry) meat is characterized by a pH higher than normal. This type of meat occurs when animals are subjected to prolonged stress or intense physical effort immediately prior to slaughter (Pisula, Pośpiech 2011, s. 231-235). Prolonged hunger and careless driving are the main reasons for the presence of DFD in meat. (Temple et al., 2014) When stress pre-slaughter lasts many hours, glycogen reserves decrease and lactic acid production and post-acidic acidosis are insufficient. DFD meat, as the name implies, is darker, drier, less tasty and more susceptible to bacterial contamination (Pisula, Pośpiech 2011, s. 244-248).

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9. CONCLUSIONS

Pig transport has a big impact on the quality of pig meat. Improper transport of pigs contributes to the stress of animals. The stress experienced during transport causes the occurrence of quality defects of meat (PSE, DFD), mechanical skin injuries, and limb fractures in animals, which affect the loss of the raw material. This is very disadvantageous for breeders and processing plants, which suffer economic losses. They strive by raising the awareness of the impact of inappropriate transport on meat quality to minimize the occurrence of stressors. The most negative impact on the welfare of animals is due to inadequate transport, because at this point animals are subjected to the greatest stresses associated with environmental change. Ante mortar (loading, unloading, transport) should be carried out by trained personnel in accordance with all standards. Animal transport vehicles must be properly designed and should ensure proper animal welfare by regulating the temperature inside the vehicle, access to food and water, and the freedom to move. Man has an influence on genetic and environmental factors affecting the quality of meat, so we should put all efforts to improve the meat raw material.

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(Received 14 June 2017; accepted 05 July 2017)