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Coherence of animal health, welfare and carcass quality in pork production chains

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ABSTRACT

Aim of the study was to measure the potential impact of animal health and welfare on the carcass quality. 99 pigs under equal housing and feeding conditions were involved in the study. Effects of the immune system on carcass composition, meat quality and performance data of slaughter pigs became measureable by quantification of acute phase proteins (APP), haptoglobin (Hp) and pig major acute phase protein (Pig-MAP). The results were not significantly affected by gender or breed. The calculated correlations between chosen animal health indicators and carcass quality parameters prove an influence of health and welfare on performance, carcass composition and meat quality traits. The acute phase proteins could also be valuable as a predictive indicator for risk assessment in meat inspection, as increased Hp concentrations in slaughter blood indicate a 16 times higher risk for organ abnormalities and Pig-MAP concentrations above 0.7 mg/ml a 10 times higher risk.

1. Introduction

Animal health was defined as the absence of disease, the normal functioning of an organism and as normal behavior by Baker and Greer (1980). In production animals, health might also be defined as the state allowing the highest productivity (Gunnarson, 2004). This definition often is enriched by concepts of a balance between the animal and its environment, and of the animal's welfare. Changes of modern veterinary medicine are linked to this broader definition. Veterinary medicine is focusing increasingly on prevention rather than cure and this makes the animal's environment and welfare important factors (Ducrot et al., 2011). Consequently, the strong linkage between animal health and welfare becomes more and more important. For both animal health and welfare, acute phase proteins are known to be well-investigated, unspecific indicators (Eckersall & Bell, 2010; Geers et al., 2003; Murata, Shimada, & Yoshioka, 2004; Petersen, Nielsen, & Heegaard, 2004). Besides the increasing aspects of veterinary medicine, the demands of consumers are changing nowadays. Branscheid, Honikel, von Lengerken, and Troeger (1998) defined carcass quality as the combination of carcass composition and meat quality. Carcass composition includes factors like percentage of valuable cuts, lean meat content, fat content and the percentage of saleable meat. Meat quality comprises technological, hygienic, sensory and nutritional quality of meat (Hoffmann, 1987). However, this definition has to be adapted to the new challenges of pork production. Consumers are more and more interested in how their food is produced, due to some outbreaks of disease that affected food safety within the last decades (Krystallis, de Barcellos, Kügler, Verbeke, & Grunert, 2009). High animal welfare standards at the production stage are demanded as this is seen to be an indicator for safe, healthy and high quality food (Fallon & Earley, 2008; Verbeke, 2001).

This study investigated the coherence of pig health and welfare, measured by acute phase protein concentrations in serum, with pig performance data, carcass quality attributes as well as organ findings through correlation coefficients.

2. Material and methods

2.1. Experimental animals

99 pigs were housed under the same conditions in the experimental farm of the University of Bonn. Twelve litters were included in the study. The pigs stayed for 30 days (±4 days) with the sows. Average weight at weaning was 8.86 kg (±2.02 kg). A maximum of 2 litters were mixed into one batch at the rearing station. Fattening started at an average age of 70 days (±4 days) and at a weight of 26.78 kg (±4.85 kg). The amount and composition of the rations were the same for all animals. The pigs were fed unrestricted with a standardized diet (13.0 MJ ME, 16.0% crude protein) during fattening. Two animals were housed in one batch together. The pigs were divided into three subgroups, for which the intervals of blood sampling differed.

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From the pigs of the intensive group up to seven blood samples, from the practical group three and from the control group only the slaughter blood samples were taken. However, saliva samples were collected from each group at each sampling time (see Fig. 1). The experimental animals originated from two different breeds. The breeds of the mother sows were Large White (n = 4) or German Landrace (n = 8), all boars were Pietrain (n = 5) breed. The different breeds were almost equally distributed over the three experimental groups, where litters were held together within experimental groups. There was nearly a balanced ratio of the gender in the experimental groups, except in the control group, which showed a predominance of female pigs (71.9%). All male pigs were castrated within the first week of life.

2.2. Sampling intervals

Saliva samples were taken starting at an average age of five weeks in regular intervals of four weeks. From the ninth week on also blood samples were collected (Fig. 1). For the control group blood samples were taken only at the time point of slaughter. The blood sampling points of the practical group have been adapted to the very important time points: at the end of rearing and beginning of fattening as well as slaughter. Only the intensive group had to undergo regular blood sampling once a month. Fig. 1 shows all sampling intervals and collected matrices.

In the intensive group the number of blood samples collected differed depending on the slaughter age. The first sampling was performed at an average age of 36.5 days (±2.75 days). From that day onwards a regular testing every fourth week was performed. The pigs were sorted for slaughter due to their weights. All pigs were slaughtered at an average weight of 108.6 kg (±3.53 kg). The average age at slaughter was 174 days (±13 days).

2.3. Sampling procedures

The saliva samples were taken using a Foerster-Ballenger sponge forceps (Instruments4you, Wurmlingen, Germany) and a Salivette® (Sarstedt AG & Co., Nümbrecht, Germany). The Salivette® contains a cotton swab which was introduced into the mouth of the pigs fixed by the forceps. The pigs chew on the swabs for about 1 min. After taking the samples, the Salivettes® were closed and stored for a maximum of 3 h at room temperature. The samples were centrifuged at 2000 U/min (950 ×g) for 10 min at room temperature using a Cryofuge 6-6 Heraeus (DJB Labcare Ltd., Newport Pagnell, England). The obtained saliva was stored at −20 °C till laboratory analysis. The results of the saliva haptoglobin analysis were used to identify systematically differences between the three groups of experimental pigs caused by the sampling procedures. Blood samples were obtained following standard procedure of good veterinary practice. The obtained serum was stored at −20 °C till laboratory analysis. The storage time for both, saliva and blood samples, was subjected to a maximum of four weeks.

Meat samples were taken 24 h post slaughter. The loin from the 14th rib cranial was collected and brought to the laboratory for further analyses. To investigate the occurrence of organ abnormalities all animals were subjected to legislated ante- and post-mortem examination in collaboration with official veterinarians in the abattoir.

2.4. Analytical methods

The concentration of Haptoglobin (Hp) was measured by a competitive ELISA developed by Hiss et al. (2003). Pig major acute phase protein (Pig-MAP) was measured using a commercial sandwich ELISA (Pig-MAP®, PigCHAMP Pro Europa S.L., Segovia, Spain) based on the method developed by Piñeiro, Lampreave, and Alava (2009).

2.5. Performance parameters

Individual body weights (BW) were recorded every third week, around the important weights of 30, 105 and 110 kg the BW was measured daily. Feed intake was recorded each day for each pen. Average daily gain (ADG, g/day) and feed conversion ratio (FCR, kg/kg) were calculated for the whole period of fattening, from the beginning of fattening till slaughter, and the period from 30 to 105 kg BW, penwise.

2.6. Meat quality

The content of intramuscular fat, water, protein and collagen in the meat samples from musculus longissimus dorsi (m. long. dorsi) was measured using near-infrared spectroscopy (NIRS). The meat samples were chopped up using a Tefal La Mulinette 1000 (Groupe SEB Deutschland GmbH, Offenbach am Main, Germany). After chopping, samples were placed in a spectrometer (NIRS™ DS2500, Foss,

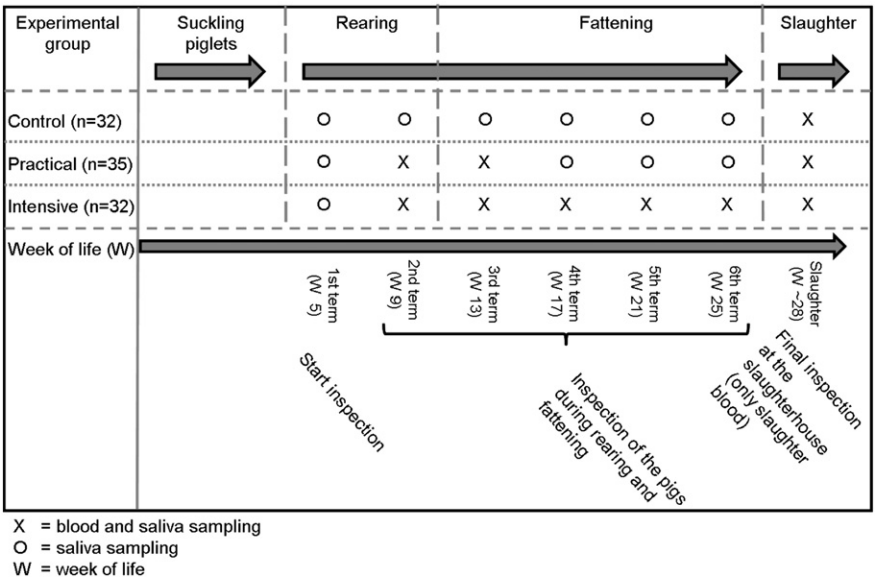

Fig. 1. Sampling intervals for the measurement of acute phase proteins.