EFFECTS OF THE HALOTHANE AND RN PHENOTYPES ON THE WATER HOLDING CAPACITY AND SOLUBLE PROTEIN IN PIG MUSCLE

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S-IVA.09

SUMMARY

The aim of the present experiments was to study the effect of the HAL and RN phenotypes on some compositional and qualitative traits in muscle biopsy samples and post mortem muscle of pigs. The HAL phenotype of Pietrain pigs was determined by the halothane test at 25-30 kg liveweight. The RN phenotype of Pen Ar Lan pigs was identified by determining the glycolytic potential in muscle biopsies at 70-80 kg liveweight. Experiment 1 involved 7 halothane-positive (HAL+) and 5 halothane-negative (HAL-) pigs. Experiment 2 involved 6 rn+ homozygous (rn+) and 6 RN- carriers (RN-). Protein soluble in phosphate buffer 0.1 M, pH 7, was determined in muscle biopsy samples and post mortem muscle (longissimus lumborum). pH, WHC (assessed by a centrifugation technique) and R value (ATP/IMP) were estimated in biopsy samples after 1 hour of incubation at 39 °C and in post mortem muscle (1 h after slaughter in Experiment 1 and 24 h after slaughter in Experiment 2). Halothane sensitivity affected significantly pH ($P < 0.01$) and R value ($P < 0.05$) in biopsy samples, and WHC ($P < 0.05$) and R value ($P < 0.01$) in post mortem muscle. Significant correlations ($r = 0.7$-0.8) were observed between biopsy and post mortem data of pH, R value and WHC. Soluble protein and WHC were lower ($P < 0.01$ and $P < 0.05$, respectively) in RN- pigs than in rn+ pigs in biopsy samples. In conclusion, the results confirm the value of the muscle biopsy procedure to predict the potential meat quality in live pigs.

Introduction

Post mortem pH change in muscle can be described by its rate and extent, which are affected by two major genes in pigs: the gene of halothane sensitivity HAL^N/HAL^n and the rn^+/RN^- gene. Halothane sensitivity due to the recessive HAL^n allele is of great concern to the pig industry, as it results in superior muscle development and inferior meat quality. It induces PSE meat, characterized by a fast post mortem pH fall, a decreased water holding capacity and paleness (Briskey, 1964). The RN^- allele results in acid meat (Naveau, 1986) which contains less protein and more glycogen than normal meat, and which presents a decreased yield when processed by curing and cooking (Monin et al., 1992). Both genes can be detected in the live animals: the HALn gene using a DNA test (Fujii et al., 1991) and the RN- gene by determining the glycogen content in a muscle biopsy (Talmant et al., 1989). So this cause of variation in meat quality can be easily controlled in pig populations. However, besides the effects of these genes, a large part of the variation in meat quality can be attributed to a polygenic determination (review by Sellier and Monin, 1994). The aim of the present experiment was to determine the influence of HAL and RN phenotypes on some compositional and physicochemical traits of muscle biopsies, and to confirm the value of muscle biopsy to predict the potential meat quality in live pigs.

Material and methods

The study involved 2 experiments. In experiment 1, 5 halothane-negative and 7 halothane-positive Pietrain pigs were identified by halothane testing at about 30 kg liveweight. In experiment 2, 6 rn+ homozygotes and 6 RN- carriers were identified at about 80 kg liveweight by the glycolytic potential test. The animals were fed ad libitum and slaughtered at about 100 kg liveweight. Just before slaughter, a biopsy sample of about 1 g was taken from the longissimus lumborum (Schöberlein, 1976; Lahucky et al., 1980). The sample was split in 2 parts. One part was immediately homogenized in phosphate buffer (0.1 M, pH 7) for determination of soluble protein (all animals) and glycolytic potential (Pen Ar Lan pigs). The other part was

incubated at 39 °C with 0.5 ml of 150 mM KCl for 1 h, then used for determination of pH, water holding capacity and R value. Samples were taken from the longissimus lumborum at 0.75 h after slaughter from Pietrain pigs, and at 24 h after slaughter from pen Ar Lan pigs, for determination of pH, water holding capacity, R value and soluble protein.

The glycolytic potential was determined according to Monin and Sellier (1985). The soluble protein was estimated according to Kalb and Bernlohr (1977): 0.5 g of tissue were homogenized in 4.5 ml of phosphate buffer (0.1 M, pH 7.4); the homogenate was left 15 min at 0 °C, then centrifuged at 10000 g ; the absorbance was determined at 230 and 260 nm and the protein content was calculated according to Kalb and Bernlohr (1977) and expressed in % of fresh tissue. R value (i.e. the IMP/ATP ratio) was determined according to Honikel and Fischer (1977) adapted to small samples (0.3 g). Water holding capacity was measured as described by Cheah et al. (1993): 0.5 g of tissue were incubated with 0.5 ml of 150 mM KCl then centrifuged at 12000 g. . WHC was expressed as the volume of supernatant fluid in ml. pH was determined directly in biopsies, in the fluid and in the pellet obtained after centrifugation in the WHC measurement.

Results

Experiment 1.

Biopsy samples showed lower pH ($P < 0.01$) and higher R value ($P < 0.05$) in halothane-positive pigs than in halothane-negative pigs (Table 1). Water holding capacity tended to be higher in the latter ($P < 0.10$). There was no difference in soluble protein content. In post mortem samples, water holding capacity was lower ($P < 0.05$) and R value was higher ($P < 0.01$) in halothane-positive pigs than in halothane-negative pigs. Significant correlations were observed between biopsy and post mortem data as well in the whole group of Pietrain pigs (Table 2) as in the group of halothane-negative animals (Table 3). Correlations were lower in the halothane-positive pigs (generally < 0.6).

Experiment 2.

The muscle glycolytic potential was markedly higher in RN- pigs than in rn+ pigs (Table 4).The soluble protein content was higher in in both muscle samples (biopsy and post mortem) of rn+ pigs. Water holding capacity was higher in biopsy samples from rn+ pigs than in those from RN- pigs, but there was no difference in post mortem samples.

Discussion and conclusion

The results of the present study were in agreement with previous observations of several authors, i.a. Lahucky et al. (1982), Von Lengerken et al. (1991) and Cheah et al. (1993) regarding HAL phenotypes. These authors showed that the pH fall is faster and the R value is higher in muscle biopsies from halothane-positive pigs than in biopsies from halothane-negative pigs. They found correlations between traits measured on biopsies (including WHC) and meat quality parameters in the same range as those reported here. The present results agree also with those of Fernandez et al. (1990) and Estrade et al. (1993) regarding RN phenotypes. These authors reported that muscle from RN- pigs has a higher glycolytic potential and a lower soluble protein content than muscle from rn+ pigs. The effect of the RN phenotype on water holding capacity of fresh meat was not reported before to our knowledge. More investigation is needed to decide if the measurements of water holding capacity and of soluble protein content in biopsies can be used as a test to identify the RN- carriers.

The results presented here confirm the interest of the biopsy technique to predict the potential meat quality of live pigs. This technique allows to discriminate the halothane-positive positive animals and the RN- carriers in pig populations. The rather high correlations found between some biopsy and post mortem data in Pietrain pigs confirm that measurements of pH and/or R value and fluid volume can identify the animals with potentially low meat quality among the halothane-negative animals.

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