COMPARISON OF THE MOLECULAR GENETIC DIAGNOSIS OF MALIGNANT HYPERTHERMIA WITH THE BIOPSY MUSCLE AND MEAT QUALITY CRITERIA OF PIGS.

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Introduction

Porcine stress syndrome (PSS) is known to be an economically important. There is experimental evidence that the PSS syndrome can be initiated by different stressors, such as halothane (Christian, 1974, Eikelenboom, Minkema, 1974) resulting in to activation of abnormal Ca2+ release mechanism (Mickelson et al., 1988) to produce malignant hyperthermia (MH). The causative mutation in the DNA fragment gene controlling the calcium release channel (Ryanodine receptor, RYR) of the sarcoplasmic reticulum can be detected by polymerase chain reaction technology (Fujii et al., 1991). Thus, in addition to halothane testing for homozygotes on MH, it is now also possible to detect heterozygotes usingì
the polymerase chain reaction restriction endonuclease, and electrophoretic detection of defective DNA fragments (Houde, Pommier, 1993).

It is well established that the gene controlling MH in pigs has a great influence on both carcass and meat quality traits. Depending on their reaction to halothane anesthesia, pigs are classified as halothane positive (H_T+_T) or halothane negative (H_T). The effects of these phenotypes on traits of economical importance has been studied extensively (Webb et al., 1982, Monin, 1989).

The major gene controlling MH causes smaller litter size, slower growth rate, shorter carcass length, larger longissimus muscle area, greater lean percentage and a higher incidence of PSE (pale, soft, exudative) pork (Webb, Simpson, 1986, Simpson, Webb, 1989). Halothane-sensitive pigs are generally assumed to yield more lean when compared with halothane-resistant pigs, but meat quality (rate of pH decline, color, water holding capacity) is inferior, and PSE frequency is higher. However, it is not always clear to what extent heterozygotes differ in meat quantity and quality from homozygous pigs.

In this paper, results are reported on the relation ship of several meat quality criteria asseced ante mortem (biopsy) and post mortem in longissimus dorsi of crossbred pigs as with RYR gene status. In addition several carcass quality and performance criteria were studied.

Material and Methods.

Using molecular genetic diagnosis of the RYR gene (Houde,
Pommier, 1993) thirty two pigs (crossbreds) of three different genotypes were chosen (homozygous negative-HN, homozygous positive - HP and heterozygotes - NP). At market weight (approx.1O5 kg) pigs were slaughtered followuing electrostunning and exsanguination. Biopsy muscle samples were taken at 8O - 9O kg ante mortem from the right side of the longissimus dorsi muscle (LD) using spring loaded biopsy technique. One part of the sample (5OO mg) was used for water holding capacity measurements, defined as "fluid volume" (F) measurement (Cheah et al., 199O). PH from fluid /F(pH)/ and pH from pellet /P(pH)/ were also measured. From
the another partion of the muscle sample (3OO - 4OO mg) pH (contact electrode) and R value (Honikel, Fischer, 1977, Lahucky et al., 1982) were determined. Both portions of the ante mortem biopsy samples were incubated in Eppendorf tubes for 45 mins at 39°C, before analysis. After slaughter meat quality traits of (pH, WHC measurements, R value and color reflectance - Minolta) were obtained. Live weight, hot carcass weight, carcass length, dressing percentage (Yield %), backfat thickness (1O rib), and visual color, firmness and marbling scores were also measured.
All statistical analyses were completed using PC programme.

Results and discussion.

As expected, homozygote positive (HP) pigs were characterised by better carcass quality and poorere overall meat quality (Tables 1,2,). Homozygous positive pigs produced higher dressing percentages,larger loin muscle areas and lower backfat thicknesses when compared with homozygous negative pigs. On the other hand, lower pH values and higher light reflectance (Minolta), WHC measurements and R values of LD samples were characterised of homozygous positive pigs what is in agreement by several other studies (Webb et al., 1982, Monin et al., 1989).

These results also suggest that the homozygous positive genotype (HP) suppresses fat deposition in muscle tissue and reduces muscle quality measurements of color, firmness and marbling. The results found in the present study confirm those of earlier reports on the halothane genotype (nn), (Elizondo et al., 1976, Zhang et al., 1992).

In general, heterozygotes (NP) were found to be intermediate for meat quality traits assessed from ante mortem (biopsy) measurements (Table 1). Differences between the three genotypic groups for meat quality traits assessed after slaughter (45 mins),(Table 1) were less consistent compared with ante mortem results. It appears that variability of meat quality parameters after slaughter were influenced by sampling and also by the results from two pigs. These two pigs were determined by DNA test and biopsy values to be homozygous negative and heterozygote, respectively, but produced PSE meat quality after slaughter inspite of simular preslaughter and slaughter conditions. Different metabolic changes and mechanisms for the expression of PSS and MHS respectively, have been discussed (Heinze, Mitchell, 1992). This observation is supported by their results whereas occurence of PSE among pigs free from the RYR gene mutation has been reported (Pommier, Houde, 1992).

Our biopsy data support the idea introduced by O'Brien (1986) that the MH, calcium release from the sarcoplasmic reticulum (skeletal muscle) and other associated metabolic traits of skeletal muscle are inherited in a codominant mode and are expressed at an intermediate level in heterozygotes.

Webb et al. (1982) summarized data comparing performance of halothane negative (HN) and positive pigs (HP) that are in agreement with our findings. In addition Sather et al.(1992) in a study of pigs of typical commercial carcass weights (75 - 95 kg), found heterozygotes to generally intermediate to the homozygotes positive and negative genotypes for a range of meat quality traits. Zhang et al. (1992) also found breeding groups with only one copy of the gene (heterozygotes),to grow rapidly and have relatively good carcass quality compared to groups with two copies
(homozygous positive).

Conclusions

The present data demonstrate agreement between (MH) genotype determined by the molecular genetic test and biopsy meat quality traits. Heterozygotes were intermediate on meat quality characteristics, grew rapidly and were additive for meat quality traits compared to the respectet homozygotes. Introducing the gene into a pig population could be usefull, in improving leanness and muscling but meat quality is certain to deteriorate.

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