RELATIONSHIP BETWEEN STRESS HORMONES AND PORK QUALITY FROM PIGS OF DIFFERENT GENOTYPES

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Background

Two main stress-responsive neuro-endocrine systems play a critical role in the regulation of energy fluxes. The hypothalamic-pituitary-adrenocortical (HPA) axis influences feeding behavior, pancreatic hormones secretion, energy expenditure, and the protein / lipid balance (Dallman *et al.*, 1993). Altogether, cortisol is the main active hormone of this axis. It is released by the adrenal cortex and favors the accretion of fat at the expense of proteins (Devenport *et al.*, 1989). Pig breeds with a lower carcass lean content like Meishan (Désautés *et al.*, 1997, 1999; Hay and Mormède, 1998) have been shown to produce more cortisol. On the other hand, catecholamines (adrenaline, AD, and nor-adrenaline, NA), which are released by the sympathetic nervous system, increase the use of energy stores (glycogen and lipids). Sympathetic activation by stress before slaughter reduces muscle glycogen content and post-mortem acidification, leading to DFD-type meat (dark, firm and dry). Techniques have become available to measure the different stress hormones of the HPA axis in urine (Hay and Mormède, 1997a,b).

Objectives

To study the differences in urinary cortisol, adrenaline, and nor-adrenaline levels of different pig genotypes in relation to pork quality.

Methods

The present data were obtained from pigs of the following genotypes: Duroc, Landrace, Large White, Meishan, and Pietrain. At around 120 kg live weights, all pigs were transported for 500 km and slaughtered at the experimental slaughter facilities of IRTA in Spain. Backfat measurements and carcass lean percentage were determined with a FOM. Urine was collected from the bladder and frozen after addition of EDTA as a preservative. The pH was measured at 45 minutes and 24 hours in the longissimus dorsi and semi membranosus muscle. Cortisol was determined in urine by HPLC with U.V. detection after extraction on reverse phase columns (Hay and Mormède, 1997a). Catecholamines were measured by HPLC with electrochemical detection after extraction on cationic columns (Hay and Mormède, 1997b).

Results and discussion

The results from the backfat and lean percentage measurements are shown in Table 1. There was a significant genotype effect ($P < 0.01$) for the parameters as expected, with the Pietrain being leaner than the Meishan pigs. No significant differences were found in pH at 45 minutes and 24 hours postmortem in this sample size.

Table 1. Carcass backfat and lean meat percentage of five different pig genotypes

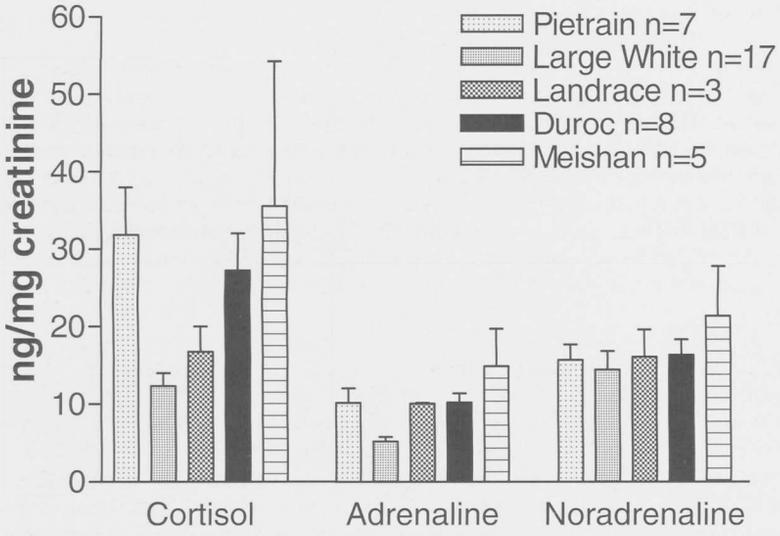
Genotype	N =	Backfat thickness in mm		Lean meat percentage	
		Mean	SD	Mean	SD
Meishan	5	28.4	5.8	40.4	6.0
Duroc	8	19.1	3.4	52.7	1.6
Landrace	4	16.8	2.9	54.7	3.5
Large White	17	15.4	2.3	57.2	2.6
Pietrain	6	13.7	3.9	58.7	4.6

Figure 1 shows the mean levels of cortisol, adrenaline, and nor-adrenaline measured in urine collected from the bladder at slaughter. The breeds are ranked in order of increasing backfat thickness (or decreasing proportion of lean meat in the carcass). Adrenaline and nor-adrenaline levels are correlated ($r=0.59$, $P<0.01$), as well as cortisol and adrenaline ($r=0.41$, $P<0.01$) both hormones being secreted by the adrenal gland, but unlike cortisol and nor-adrenaline ($r=0.30$). Except for the Pietrain strain, there is clear positive relationship between cortisol (and therefore adrenaline) levels and fatness, which reflects the metabolic actions of glucocorticoid hormones.

The present data must be considered as preliminary since the number of animals in each breed is small. They show that stress hormones from the adrenal cortex (cortisol) and the sympathetic nervous system (catecholamines) influence important traits for pork production. It cannot be said from the present study whether the variations found in urinary levels of hormones result from differences in basal secretion or in response to preslaughter stress or in both. However, the relationships between cortisol levels and structural measures like backfat thickness or muscle yield demonstrate that stable differences in the HPA axis activity are probably involved. It is now well established that genetic factors influence individual variations in stress behavioral and neuro-endocrine responses.

Genetic selection on stress reactivity traits could improve both animal welfare and product quality. Furthermore, QTL's related to these traits have been recently mapped and open the way to the identification of the molecular mechanisms involved in individual differences in stress responses (Bidanel *et al.*, 2000). Future research will focus on the identification of the correlations between urinary stress hormones, pig welfare, and different pork quality traits (i.e. see EU project at www.qualityporkgenes.com)

Figure 1. Cortisol, adrenaline, and nor-adrenaline measured in urine collected from the bladder at slaughter of pigs of different genotypes.



Pertinent literature

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