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INFLUENCE OF REARING SPACE ON THE CARCASS AND MEAT QUALITY OF PIGS

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Introduction

In recent years consumers have become more and more focused on the way that food is produced and the increasing intensification of farming has been perceived as a negative development. It should be pointed out that there are variations in the emphasis that consumers put on the welfare of animals, when they buy meat. It is generally accepted that environmental enrichment with substrates improves the welfare of growing pigs (Wood – Gush and Beilharz, 1983). In addition, high levels of pen mate – directed behavior in barren rearing environments have a negative effect on the productivity of pigs due the disturbances in feeding patterns (Ruiterkamp, 1987). Growth rates of pigs are affected by elevations of the stress hormones. The responses to stress factors is the releases of neurotransmitters in the brain, which stimulates the nervous system and releases stress hormones into the blood, which might stimulate muscle metabolism negatively in relation to subsequent pork quality (Rosenvold et al., 2003). Meat quality may also be affected by rearing environments. Poor on farm handling increases the susceptibility to pre – slaughter stress (D'Souza et al, 1998). Pale, soft and exudative (PSE) meat can be influenced by levels of preslaughter stress (Geverink, 1998).

The objective of the present study was to access the effects of rearing space on growing pig's performance and meat quality.

Material and methods

A total of 120 crossbred female and castrated male pigs [(Danish Landrace x Danish Yorkshire x Danish Duroc)] were raised under experimental conditions from October to January. All the animals were allocated in two groups when they were approximately 100 days of age. Animals were kept indoors in 10 pens with slatted floors. 60 of pigs (control group) were raised in pens with minimum recommended space allowances (0,5 m^2/ per pig) and other 60 (searching group)- respectively 1,2 m^2/pig. All pigs used in this study had been tested as free of the detrimental alleles of both the Halothane and RN genes. Both environments at all stages had a day/night cycle, with full lighting between 08^{00} and 17^{00}

hours, temperature was maintained 15 – 20 ^{o}C and relative humidity of the air was respectively 65 – 75 %. Animals were given conventional feed mixture *ad libitum* 7 times per day using sensory wet feed feeders and water was available all the time. Pigs were sent to a slaughter at the 97th day of fattening (average of weight of each approximately 114 kg). The pigs were transported to a local slaughterhouse and kept in lairage for 2 h with their original pen mates before being stunned and slaughtered.

In total, 20 carcasses were subjected to carcass and technological meat quality studies; 10 control pigs and 10 searching pigs. Carcasses were weighted and then lean meat percentage was measured with an optical probe Fat'o Meater. After that, carcasses were chilled at 2^{o}C. The pH of the Longisimus Dorsi muscle was measured 45 min (pH_1) and 24 hours post mortem (pH_2) using an electrode probe connected to a portable PH meter. Measurements were made at 5 cm depth, in the region of the last rib and from the left rib respectively. All other meat quality investigations were carried out on samples of muscle L. Dorsi. These were removed from the carcass 24 hours post mortem from the left dorsal area of the carcass in the region of the last rib and brought to the laboratory. No deaths of pigs were registered during this study.

Results

There was small effect of the treatments on growth rate. quality Results are given in table 1. Pigs from the enriched environments had higher growth rates than pigs from the barren environment and were heavier at the slaughtering. Carcass characteristics of the animals from two environments differed significantly. Animal carcasses from enriched environment were much heavier and had lower lean meat percentage than carcasses of the animals from the barren environments.

Table 1. Average Performance and carcass quality

PARAMETER	Environment	
	0,5 m^2/pig	1,2 m^2/pig
Weight at the beginning of the experiment, (kg)	39,0 ± 0,31	39,5 ± 0,28
Weight at the slaughtering, (kg)	113,0 ± 0,81 ***	117,9 ± 0,68 ***
Growth rate, (g/day)	760 ± 0,74 ***	800 ± 0,80 ***
Dressing percentage, %	73,18 ± 2,08 *	79,74 ± 2,25 *
Carcass weight, (kg)	82,7 ± 3,81 $^{n.s.}$	93,3 ± 4,30 $^{n.s.}$
Lean meat, (%)	52,5 ± 2,78 $^{n.s.}$	54,3 ± 2,41 $^{n.s.}$

n.s. - not significant;* p< 0,05; **p< 0,01; ***p< 0,001

Meat quality results are given in table 2. There was environmental effect for most of the meat quality measurements, although it was not very significant. The enriched environments affected lower meat pH, greater water holding capacity and lower shear force comparing to pork from barren environments. Although, parameters of the colour (L^*, a^*, b^* values) were influenced negatively.

Table 2. Meat quality results

PARAMETERS	ENVIRONMENTS	
	0,5 m^2/pig	1,2 m^2/pig
Meat pH 45 min *post mortem*	6,18 ± 0,02 $^{n.s.}$	5,88 ±± 0,20 $^{n.s.}$
Meat pH 24 h *post mortem*	5,61 ± 0,009 ***	5,64 ± 0,007 ***
Color L^* parametr	49,81 ± 0,42 $^{n.s.}$	52,24 ± 1,08 $^{n.s.}$
Color a^* parametr	17,42 ± 0,28 $^{n.s.}$	16,24 ± 0,21 $^{n.s.}$
Color b^* parametr	7,02 ± 0,40 $^{n.s.}$	7,53 ± 0,30 $^{n.s.}$
Water holding capacity, %	50,57 ± 1,50 $^{n.s.}$	51,21 ± 1,39 $^{n.s.}$
Shear force, kg/cm^2	1,57 ± 0,13 $^{n.s.}$	1,40 ± 0,12 $^{n.s.}$

n.s. - not significant;* p< 0,05; **p< 0,01; ***p< 0,001

Discussions and conclusions

This study agrees with previous similar studies. Pigs from the enriched environments had higher growth rates than pigs from the barren environment. Carcass characteristics of the animals from two environments differed significantly. Animal carcasses from enriched environment were much heavier and had lower lean meat percentage than carcasses of the animals from the barren environments. Previous studies on the influence of rearing space on productive performance in pigs have conflicting results. Some reports no difference in fat depths for pigs reared at different floor-space allowances (Brumm, 1996; Edmonds, 1998; and Edwards, 1988). Whereas, Schaefer et al. (1990) and Horrel (1992) found that enriching the environment of pigs improves their growth rate. Ruiterkamp (1987) associated high levels of pen mate – directed behaviour with reduced feed intake in growing pigs. In our study it is possible that higher levels of harmful social behaviour in barren pens led to lower fed intakes during the finishing period. This type of behaviour may also lead to higher to higher level of stress, which affects food conversion negatively (Barnett et al., 1983). Effect of rearing space influenced most of the meat quality parameters, although it was not very significant. The enriched environment affected lower meat pH, greater water holding capacity and lower shear force comparing to pork from restricted environments. All parameters of the colour (L^*, a^*, b^* values) were influenced not significantly. In other studies (Hamilton et al., 2000) found the only effects of housing environment on pork quality Minolta L^* values and lipid levels which were higher for pigs housed in the spacious compared to the crowded environment. Therefore,

the suggestion from the current study of a negative effect of rearing environment on muscle colour and water-holding capacity requires confirmation across a wider range of rearing environments. Studies that have reported on the effects of rearing environment on pork quality characteristics have generally compared different production systems rather than different environments within the same system, as in the present study, and have produced conflicting results. Enfalt et al. (1997) found a lower ultimate pH, higher drip loss, increased shear force values, and reduced intramuscular fat for outdoor compared to indoor reared pigs. Wariss et al. (1983) reported that pigs reared intensively had paler meat than pigs reared in a non-intensive environment. In contrast, Jones et al. (1994) and van der Wal et al. (1993) compared pigs from outdoor and indoor production systems and found no differences in *longissimus L** values. Geverink, de Jong, Lambooij, Blokhuis, and Wiegant (1999) compared pigs reared either in intensive housing conditions or in more extensive conditions, in pens with more space and with straw provided, and found no differences in pork quality between the two environments.

In our study Minolta *L** values and lipid levels were higher for pigs housed in the spacious compared to the crowded environment. But, the enriched environment affected lower meat pH, greater water holding capacity and lower shear force. A possible explanation for the treatment difference is that enriched pigs had higher levels of intramuscular fat which has been previously associated with the improved tenderness and water holding capacity in pork (Candek – Potokar et al., 1999). This is supported by the finding that pigs from enriched environments had significantly greater levels of back fat, which generally results in higher levels of intramuscular fat (Barton – Gade, 1987).

It can be concluded, that improvements in pigs behavior, performance and meat quality characteristics may be substantial when the difference in housing conditions is large.

Spacious environment influenced mainly carcass quality traits, technological meat quality to a lesser extent. Further investigations should investigate the impact of fully enriched environment (access to outdoor pastures, beddings) on pig's behavior, performance and meat quality.

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