The Effect of Strawbedding on the Physiological Response to Preslaughter Treatment, Skin Damage and Carcass and Meat Quality in Pi

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Background

Current pig housing systems which are characterised by barren environment may produce excitable and hard-to-handle pigs throughout pre-slaughter stages (*Grandin, 1991*). Excitement and overxertion lead to reduced welfare of pigs prior to slaughter and lower meat qua (*Faucitano et al., 1998*). Among the different housing factors affecting the behavioural response of pigs prior to slaughter, the floor design in fattening pen is considered as a major factor (*Grandin, 1991*). Despite its decline in favour of concrete flooring for economical and practi reasons, strawbedding proved beneficial in terms of health, welfare and easiness of handling of pigs (*Grandin, 1991*; *Willequet et al., 1991*; *de Jo et al., 1998*). However, there is a limited knowledge on the effects of strawbedding on the growth performances and the carcass and meat qua traits yet. In some studies, the combination of strawbedding and activity increased the growth rate and subsequently the carcass weight (*Knowles al., 1993*), whereas in other studies no effect was recorded (*Beattie et al., 1995*). As the presence of straw in the fattening pen promotes explorat and playing activities (*Arey, 1993*), one could suppose an increased aerobic metabolism of the muscles involved in the physical activity. This wo favour the removal of waste products (lactate) from the muscle fibres prior to slaughter limiting the acidification rate of the post mortem muscle consequently preventing the onset of the PSE defect in the meat (*Essèn-Gustavsson, 1995*),

Objective

To give scientific evidence to the personal observations (*Grandin, 1991*) on the beneficial effects of the use of strawbedding during growing-fattening period on the pig physiological response prior to slaughter and on the carcass and meat quality attributes.

Methods

Forty crossbred (LW x BL) pigs divided into four groups (10 pigs each) were reared separately in four pens (10 pigs/pen) from weaning u slaughter age (4 months) in an integrated pig farm placed in Southern Brazil which included a slaughter facility. Two pens had a concrete floor w strawbedding (S group), whereas the others two, considered as the control group, had a full bare-concrete flooring (C group). The rearing characteristics (i.e. shape, size and building material) were the same for all groups. Both groups were fed *ad libitum* a normal commercial diet had a continuous water supply. Preslaughter conditions were the same for all groups. Mixing was practised al loading and at unloading betw groups within the same treatment and slaughter was performed by manual electrical stunning followed by prompt horizontal bleeding.

At exsanguination, twenty-four blood samples were randomly collected from a representative number of pigs (12/treatment) in pla containers and allowed to clot in order to get serum. Within 1 hour of collection, the serum was taken and then ice-stored during transportatio the laboratory where it was frozen (-20°C) pending the analisys for creatine-phosphokinase (CPK) enzyme (log UI/l) and cortisol (μg/100 concentration. CPK assessment was carried out by using a Wiener CK-NAC Kit (Wiener Laboratories), whereas the blood level of cortisol evaluated by radio-immunoassay (RIA).

Hot carcass weight was determined. The amount of skin damage on the carcass was subjectively evaluated using a five-point scale based subjective photographic standards (*MLC, 1985*). Carcasses were scored as having: none (category 0), light/moderate (category 1-2), very m (category 3-4) to severe (category 4-5) skin damage.

Glycolysis rate was objectively assessed at 50 minutes *post mortem* by measuring pH (pHmeter TM37, Wert, Germany) in the *Longissi dorsi* (LD) and *Semimembranosus* (SM) muscles. Colour score was evaluated subjectively at 24 h *post mortem* according to photographic co standards, from 1 (extremely pale) to 5 (extremely dark) (*Agriculture Canada, 1984*).

Meat composition (water, intramuscular fat, crude protein and total pigments contents) were determined on LD muscle samples taken at level of the last rib in each carcass. The water content (%) was evalauted by oven drying a 2 g sample for 16-18 h at 100°C. Crude protein (content (%) was analysed with the Kjeltec apparatus (macro-Kjeldhal, São Paulo, Brazil) using the factor 6.25 when calculating the proportio proteins. The intramuscular (IMF) content (%) was measured by spectrophotometry after sample centrifugation (*Terra and Brum, 1988*). concentration of pigments (ppm) was assayed from the total haem (*Hornsey, 1956*).

The data were analysed statistically by the Statistical Analysis System (*SAS, 1988*), using the General Linear Model (GLM).

Results and discussions

As shown in Table 1, there was a significant effect of the floor type on the hot carcass weight, being higher in S pigs (63.8 *vs* 57.4 P<0.001). This result agrees with the findings of Knowles et al. (1993) who found a higher growth rate in pigs kept in an enriched environm during fattening. However, this greater weight gain may have been also caused by the higher food ingestion induced by the increased phys activity (*Pearce, 1993*), which was not measured in this study. Skin damage score was significantly higher on the carcasses of C pigs (1.35 *vs* 0. P<0.01), being 70% of them very much damaged (score 3-4). This result would indicate that C pigs were harder to handle and were thus subje to a rougher handling from the handlers. Strawbedding only had an effect on the glycolysis rate (pH_{50}) of the SM muscle, which was faster in th carcasses than in C carcasses (6.12 *vs* 6.32, P < 0.05). A higher acidification rate in pigs kept in enriched environments has been also observe Geverink et al. (1998) and may be due to the higher muscle glycogen levels before slaughter. However, contrary to the findings of these auth this higher acidification rate did not produce any significant changes in the ultimate colour of these muscles and meat can be still considere normal technological quality.

When compared to the loins from C carcasses, the loins from S carcasses contained less water (72.7 *vs* 74.01%, P<0.001), more pigments (48.6 33.57 ppm, P<0.001) and a higher concentration of IMF (3.83 *vs* 1.88%, P<0.001). Supposingly, these differences may be the result of the hi

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physical activity induced by strawbedding. Indeed, also Enfalt et al. (1997) found a lower water content in out-doors pigs. The higher content of pigments and IMF may reflect the increased proportion of oxidative fibres in the LD muscle induced by exercise (*Essén-Gustavsson, 1995*). However, the higher IMF could also be the result of higher food intake. The lack of difference in the CP content may suggest that C and S carcasses were equal in carcass leanness. The CPK level in blood increased in C pigs (3.78 *vs* 3.41 log UI/l, P<0.001) showing that the physical stress experienced by these pigs was greater compared to S pigs. The lack of significant difference in the cortisol concentration, although it approached significance (P=0.053), may be due to the higher basal level of cortisol in the blood of pigs kept on straw during fattening as reported by de Jong et al. (1998), which may have prevented a further increase.

Conclusions

Enriching the pen environment with strawbedding increases the growth rate, it helps to reduce the number of bruised carcasses by making pigs easier to handle throughout the preslaughter stages and it improves the capacity of pigs to withstand the physical and emotional stressors without affecting the technological meat quality. The higher contents of IMF and pigments in the loin would suggest the occurrence of changes in the muscle metabolism induced by an increased physical activity. Given the promising results of this pilot study, further research is needed to study the benefits of strawbedding on pig welfare and meat quality by including the objective evaluation of the pig behaviour both on farm and prior to slaughter and the analysis of the muscle metabolism changes.

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Table 1. Least square means (LSM) and standard errors (SE) of carcass and meat quality attributes and blood parameters in the two treatment groups

	Straw		Concrete		Significance
	LSM	SE	LSM	SE	
Hot carcass weight (kg)	65.0	1.06	59.7	1.06	***
Skin damage score[a]	0.75	0.17	1.40	0.17	**
pH_1 (LD)					
pH_1 (SM)	6.12	0.06	6.32	0.06	*
Colour score (LD)[b]	2.50	0.11	2.52	0.11	NS
Colour score (SM)[b]	2.52	0.11	2.72	0.11	NS
Composition of the LD :					
Water (%)	72.7	0.18	74.01	0.18	***
Crude protein (%)	21.47	0.25	21.48	0.24	NS
Haem pigments (ppm)	48.65	2.17	33.57	2.17	***
IMF (%)	3.83	0.23	1.88	0.23	***
CPK (logUI/l)	3.41	0.08	3.78	0.06	***
Cortisol (mg/100ml)	1.19	0.12	1.29	0.09	NS

[a]: 0 to 5 photographic scale (MLC, 1985); [b]: 1 to 5 colour standards (Agriculture Canada, 1984); * (P<0.05); ** (P<0.01); *** (P<0.001); NS: not significant