The influence of straw enrichment on hair hormone levels, behaviour, and productivity

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APPLICATION FOR PRODUCERS

Determining the chronic stress levels of your herd by shaving hair and sending it in for hormone analysis could be useful when you're looking at making changes in your management or environment to improve welfare, and to support research on verification of good animal care practices. Shaving hair is non-invasive and relatively easy to do. Currently, more research is needed to determine whether hair hormone levels are valuable biomarkers of chronic stress.

Nursery pigs are enjoying the area of the pen that has a solid mat, either with or without straw provision

SUMMARY

A trial was conducted to see if hair hormone concentrations are a good biomarker for chronic stress in pigs. The objective of this study was to determine if different rearing environments, designed to be standard, or improve pig welfare, influenced the hair hormone concentrations of cortisol, cortisone, DHEA, and their ratios. Pigs (n = 192) were raised from birth to slaughter in standard fully slatted barren pens (Control) or slatted pens enriched with daily straw provisions (Straw). Straw enrichment did not influence hair hormone concentrations or their ratios at 12 and 20 weeks of age. Pigs raised with straw had a lower frequency and duration of negative behaviours (aggression) and a higher frequency of positive behaviours (foraging, play) than control pigs at some, but not all, stages throughout the growing life. Pigs raised with straw had lower skin lesion scores on d27, d56 and d137, improved ADG in the nursery and less tail bites. The behaviour and skin lesion data suggests that pigs raised with straw had improved welfare at some, but not all stages of production, but hair hormones were no different between the populations of pigs. Continued research will look at whether this lack of effect was due to the hair hormone concentrations not being sensitive enough to detect welfare differences, or because provision of straw may not have resulted in great enough changes to reduce chronic stress, or because pigs don't experience high levels of chronic stress to begin with.

INTRODUCTION

Cortisol and dehydroepiandrosterone (DHEA) are two hormones released during the stress response and have been suggested as biomarkers of stress in swine. These hormones can be measured in blood, urine, saliva, hair, and feces. The measurement of these hormones in blood and saliva has been used to evaluate acute stress, but measures of chronic stress are lacking. Hormones within hair may provide insights into the levels of stress over a longer period of time as the hormones integrate into the hair during growth. Hair also has the advantage of being non-invasive and having a painless sample collection, in addition to being easily stored for later analysis. Besides cortisol, additionally measuring the hair cortisone concentration has been suggested as a more sensitive measure of stress in pigs.

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Rootable materials for enrichment such as straw allow pigs to partake in highly motivated species-specific behaviours such as exploration and foraging. Straw was tested as the treatment for improved housing conditions as providing straw may not only be beneficial by reducing unwanted behaviours, but also by promoting positive welfare states through providing an outlet for the highly motivated behaviours. Providing such occupational activities that can promote positive states and reduce negative behaviours such as biting of pen mates can support a reduction in chronic stress.

A study was conducted to measure the hair hormone concentrations of cortisol, cortisone, DHEA, and their ratios to explore their potential as biomarkers of chronic stress through comparing pigs raised in barren environments versus those enriched with straw. The objective of this study was to determine if straw as environmental enrichment influenced hair hormone concentrations, suggesting a reduction in chronic stress.

EXPERIMENTAL PROCEDURES

Pigs (n = 192) were raised in two batches (May-September and August-January) from birth to slaughter and were divided into two treatments; standard fully-slatted pens (control) or fully-slatted pens enriched with daily straw provisions. Pens of control pigs were housed in barren housing with no additions to the farrowing environment. Control pens received point-source enrichment in the form of one metal chain in the nursery period and two metal chains in the grower period, at shoulder height, one with a 61 x 122 cm piece of wood attached for growers only. Pens of enriched pigs received the same point source enrichments plus daily straw provision (Table 1). Straw was provided on top of a solid rubber mat that was also installed in control pens.

Table 1. Amount of straw provided per pen of enriched pigs on a daily basis throughout the trial.

Stage of production, age in days	Daily amount of straw provision per pen
Lactation, 3-10 d	500 mL
Lactation, 10-24 d	2.6 L
Nursery, 25-52 d	20 L
Grow-finish, 53 d – slaughter	40 L

At 12 and 20 weeks of age 64 pigs had hair shaved off the left rump. Hair was analysed for concentrations of cortisol, cortisone and DHEA, and the cortisol:DHEA and cortisone:cortisol ratio calculated. Behaviour and postures were recorded post-weaning (d24), at the end of the nursery (d52), beginning of the grower stage (d53 and d56), the middle of the grower stage (d88) and the end of the finisher stage (d137).

Skin lesions were recorded pre- and post- weaning (d23 and d27) pre- and post- grower move (d52 and d55) and prior to slaughter (d137) using a score of zero to three, with zero indicating no lesions and three indicating severe lesions. Body weights were collected to calculate average daily gain (ADG) at birth and at the entry and exit of each stage of production (d23, d54, d88, d137).

RESULTS AND DISCUSSION

Hair hormone concentrations: Treatment did not influence hair hormone concentrations or their ratios both at 12 and 20 weeks of age. There was an interaction (P=0.020) between treatment and batch for DHEA concentration in hair at 12 weeks; in batch 1, pigs enriched with straw had lower DHEA concentrations than control pigs, whereas in batch 2, the opposite was true. Cortisol was higher in batch 1 than batch 2 for both treatments, reflecting potential seasonal differences in hormone concentrations.

Negative behaviour: Pigs raised with straw had a lower frequency and duration of aggression on the day pigs were moved into the grower unit (d53) but there was no treatment effect at other time points. Control pigs had a higher frequency of belly nosing on d52 and d88 and a longer duration of belly nosing on d88 than pigs with straw, with very low occurrence at all other timepoints in both groups, with levels too low to run statistical analysis. There were also not enough occurrences of oral manipulation of pen mates throughout the trial to do statistical analyses, except on d52 when there was no effect of treatment on frequency or duration of oral manipulations.

Positive behaviour: Pigs with straw tended ($P<0.10$) to have a higher frequency of exploratory behaviour directed towards the straw or environment on d24 and d56 and had significantly ($P<0.05$) higher frequency of exploratory behaviour on d88 and d137 compared to control pigs. Duration of exploratory behaviour was longer for pigs with straw vs. control pigs on d56, d88 and d137. The frequency and duration of play behaviour was higher for pigs with straw than control on d53, but no different between treatments on d52 and d54. Play was not observed at levels great enough for statistical analyses on d24, d27, d88 and d137.

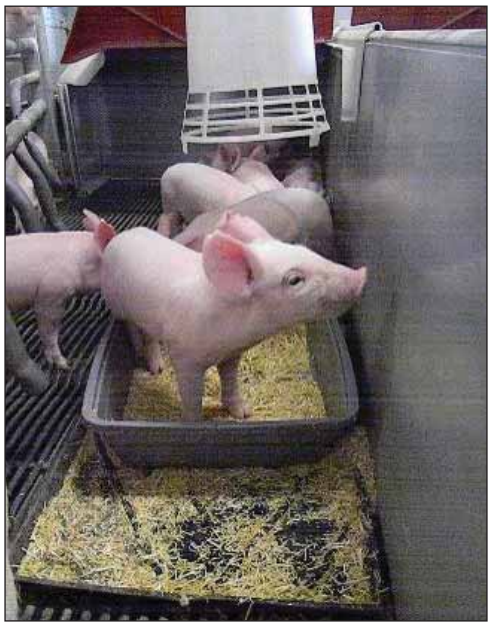
Postures: Treatment did not affect the proportion of pigs laying down until d88, when a higher proportion of control pigs were laying down compared to pigs raised with straw, whereas on d137 control pigs tended to lay down less than pigs with straw. A higher proportion of straw raised pigs were standing on d24, and d88 (tendency) than control pigs, whereas on d137 the opposite was true (tendency). Treatment did not affect the proportion of pigs sitting, except on d137 when there was a tendency for control pigs to sit more.

Shaving hair off a pig

Skin lesion scores and tail bites: Control pigs had higher skin lesion scores than pigs with straw on d27, d56 and d137, whereas treatment did not affect skin lesion scores on d23 and d52 (Table 2). Tail bites were only observed in the last four weeks of the trial (d109-d137); the percentage of bitten pigs being 5.21% of control pigs vs. 1 % of straw reared pigs.

Table 1. Skin lesion count (the sum of skin lesion scores of the head, ears, body, and tail using a rating of 0 (mild lesions) to 3 (severe lesions) of pigs reared in a barren environment (Control) or enriched with straw (Straw) at different time points throughout life. Results are presented as the mean, with 95% confidence intervals in brackets.

Item	Treatment		*P*-value
	Control	Straw	
Pre-weaning (d23)	0.44 (0.19, 0.69)	0.78 (0.44, 1.12)	0.12
Post-weaning (d27)	2.28 (1.87, 2.70)	3.13 (2.64, 3.62)	0.01
End of nursery (d52)	1.59 (1.11, 2.08)	1.97 (1.50, 2.44)	0.28
Start of grow-finish (d56)	2.47 (2.11, 2.82)	3.44 (3.02, 3.85)	0.001
End of grow-finish (d137)	0.94 (0.72, 1.15)	1.41 (1.17, 1.64)	0.01



Farrowing room setup for pigs raised with straw enrichment

Growth rate: Pigs raised with straw tended to have a higher average daily gain in the nursery period compared to control pigs (0.484 kg vs 0.441 kg, respectively). Treatment did not affect ADG at other time periods.

Grower room setup for pigs raised with straw enrichment

IMPLICATIONS

Daily provision of straw from birth to slaughter did not affect hair hormone concentrations or their ratios. It is unclear whether this lack of effect was due to the hair hormone concentrations not being sensitive enough to detect welfare differences, or because provision of straw may not have resulted in great enough changes to reduce chronic stress, or because pigs don't experience high levels of chronic stress to begin with. The behaviour and skin lesion data suggests that pigs raised with straw had improved welfare at some, but not all, stages throughout their growing life. Future research is required, particularly studies including physiological and behavioural measures as a means for cross validation to determine whether cortisol, DHEA and the cortisol:DHEA ratio are valuable biomarkers of chronic stress, and studies looking at the effect of different rearing environments on stress and welfare in swine.

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