ENRICHING THE ENVIRONMENT OF GROUP HOUSED SOWS USING STRAW / HAY IN RACKS

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Executive Summary

Although it is generally viewed that group housing of gestating sows will improve their welfare, group housing situations are also associated with sow – sow aggression. In stable groups, this aggression is typically witnessed around the time of mixing, as well as around feeding. Aggression can induce both acute and chronic stress, which has negative consequences for both welfare and production and, therefore, attention should be given to reduce aggressive interactions in order to diminish stress at mixing and feeding. In addition to reducing negative interactions, group housing systems should also be managed so as to provide sows the opportunity to perform behaviours, such as foraging, that might otherwise be restricted.

The provision of straw and other fibre sources can benefit group housed sows in a number of ways. The highest levels of aggression are witnessed around feeding as sows fight for limited resources. Straw increases the fibre content of feed, which alters gut transit time and the feeling of satiety. Sows fed high fibre pelleted diets have previously been shown to display reduced aggression (van Wettere, 2012). Straw also provides environmental enrichment in concrete/slatted pens. A reduction in the exploration of pen fixtures has been observed in sows given access to straw racks (Stewart et al., 2008). This is thought to have occurred as sows with access to straw were given an outlet for foraging behaviour. Additionally, the provision of silage has been shown to alleviate stereotypies such as sham-chewing (O'Connell, 2007). Whilst these last investigations identified no difference in aggression, the sows were housed in dynamic groups and fed via electronic sow feeders.

Previous studies have identified that access to straw or silage reduced the incidences of negative welfare indicators (aggression and stereotypies) as well as increasing positive behaviours (foraging) in group-housed sows. What is not known is whether continual access to a fibre source reduces physiological and behavioural indicators of stress in sows housed in stable groups, and whether fibre and type of fibre affects reproduction. The current study, therefore, determined the effects of providing sows access to straw or hay in racks or no substrate on sow behavior, aggression and reproductive output.

A total of 890 sows were used in this experiment, with animals allocated randomly to be housed in groups containing either an empty rack (Control; n = 299 sows), a rack filled with straw (STRAW; n = 301) or a rack filled with oaten hay (HAY; n = 290). There were two racks per pen (~ 60 sows / pen), with racks filled daily with 200g of substrate / sow / day. Each sow was allocated 2.1 kg/day gestation mash feed from the ESF (electronic sow feeder) system. Sows were mixed into groups on day 42.1 ± 0.2 (CONTROL), 42.4 ± 0.2 (STRAW) and 40.9 ± 0.2 (HAY) of gestation. Sows were weighed and P2 backfat recorded at entry and exit (day 110) from the pens, with litter size data recorded for 203, 231 and 224 sows from the CONTROL, STRAW and HAY treatments, respectively. Per treatment, there were 75 focus sows, from which scratch scores, injury scores and locomotion scores were determined on the day prior to mixing and 30 days after mixing. Sow behavior was recorded by analysis of 4 hour video recordings collected on days 2, 9 and 30 post-mixing.

There were no treatment effects on the incidence of fighting observed; however, the number of fights decreased significantly with day relative to mixing ($P < 0.01$). Interestingly, the type of substrate in the rack significantly affected guarding behavior as well as exploration of the rack ($P < 0.01$), with the incidence of guarding higher in the HAY compared with CONTROL and STRAW treatments. However, there was a significant interaction between treatment and day for number of times sows explored the rack and associated substrate. There were short amounts of time with the CONTROL sows explored the rack, however, this was negligible and therefore, the exploration of the rack and substrate in the CONTROL group was significantly lower than both other treatments on all days. Interestingly, on day 9

and 30 post-grouping, the STRAW sows explored the rack and substrate significantly more times than those supplied with HAY, but no difference seen between the STRAW and HAY group on day 2 ($P < 0.01$). Total scratch scores were 5.97 ± 0.44, 4.97 ± 0.39 and 5.03 ± 0.39 for CONTROL, HAY and STRAW treatments ($P = 0.204$), and were unaffected by day relative to grouping. However, there was an interaction between treatment and day relative to grouping ($P < 0.05$) for locomotion scores (0 = no signs of lameness and 3 = severely lame). On day 2 post-grouping, locomotion scores were unaffected by treatment; however, on day 30 post-grouping locomotion score was lower for sows in the HAY (0.017 ± 0.05) compared with STRAW (0.18 ± 0.05) and CONTROL (0.24 ± 0.05) groups.

The proportion of sows removed from the ESF pens tended to be lower ($P < 0.1$) for the HAY compared with CONTROL treatment (15% versus 21%) and was significantly lower ($P < 0.01$) in the STRAW compared with CONTROL treatment (12% versus 21%). Weight gain was higher for the sows in the CONTROL and HAY compared with STRAW treatment: 26.6 ± 1.37 and 24.9 ± 1.30 versus 17.8 ± 1.28; $P = 0.016$. Sows in the STRAW treatment gained less P2 backfat compared with those in the HAY treatment ($P < 0.01$); -0.07 ± 0.28 versus 1.45 ± 0.28 mm. Total litter size was higher ($P = 0.04$) in the STRAW compared with CONTROL treatment (13.5 ± 0.21 versus 12.8 ± 0.22), as was the number of stillborn piglets per litter (1.1 ± 0.08 versus 0.7 ± 0.09; $P < 0.01$). The number of live born piglets was similar for the CONTROL (11.95 ± 0.20), HAY (11.94 ± 0.19) and STRAW (12.2 ± 0.19) treatments. However, the number of mummified fetuses per litter was significantly higher for the STRAW (0.23 ± 0.03) and HAY (0.21 ± 0.03) compared with CONTROL (0.09 ± 0.03) treatments ($P < 0.01$). The number of piglets dying with 24 hours of parturition was 0.64 ± 0.07, 0.59 ± 0.06 and 0.52 ± 0.06 for the CONTROL, HAY and STRAW treatments, respectively ($P = 0.412$). The number of piglets dying per litter between day 1 and weaning was 1.05 ± 0.10 (CONTROL), 0.89 ± 0.10 (HAY) and 0.86 ± 0.09 (STRAW) ($P = 0.347$). Regardless of treatments, and despite similar total litter sizes, sows with gestation lengths shorter than 115 days had higher incidences of pre-weaning mortality within 24 hours of parturition and between day 1 and weaning.

Overall, these data indicate that the provision of straw or hay in racks does not appear to affect aggression levels within the pen. However, similar to the majority of Australian studies, aggression was only high immediately after mixing and reduced to very low levels by days 9 and 30 post-group formation. Sows did spend time exploring and manipulating the straw and hay. Based on guarding behavior it would appear that hay was a more highly valued substrate than the straw. However, time spent exploring the rack and associated substrate was higher for longer post-grouping in the STRAW treatment, perhaps suggesting that the guarding of the hay reduced the use of the substrate. Interestingly, the provision of straw in racks reduced weight and P2 gain, suggesting that straw may have reduced appetite, and thus concentrate consumption. Alternatively, fewer sows were removed from the STRAW treatment for not using the ESF (not-eating), which could be interpreted as reduced competition for the feeder due to increased substrate use. A similar trend was observed in the HAY treatment, which would substantiate the notion that the provision of a foraging substrate may have reduced guarding of the ESF by dominant sows, thus allowing more sows to gain access and consume, at least some of, their daily ration. The increased stillbirth rates observed in the STRAW treatment may reflect the reduced weight gain of these sows, and thus inappropriate metabolic state at weaning; however, total litter size was also higher in these sows which could have also contributed to this effect. Unfortunately, piglet weight at birth was not recorded, but should be investigated in sows receiving either straw, hay or no substrate during gestation. The increased incidence of mummified fetuses observed in both substrate treatments is interesting, but was not sufficiently high to negatively affect either born alive or piglets weaned per sow. Taken together, these data indicate that

providing substrate in racks did not affect incidences of aggressive behaviours amongst sows housed in groups and fed via ESFs. The provision of straw as a substrate appears to be most beneficial in terms of promoting substrate focused (foraging) behavior throughout the period investigated. However, the provision of Hay was associated with increased guarding behaviours, indicating increased value to the sow, but also reduced lameness, and no impairment of sow weight and P2 gain during gestation.

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1. Introduction

Group housing of gestating sows is widely perceived as improving their welfare. However, the aggression which inevitably occurs when sows are mixed into, and remain in groups continues to impair sow welfare, particularly lower ranking sows. The causes and timing of sow aggression within groups has been extensively reviewed (eg Greenwood et al., 2014) and in stable groups, aggression is typically witnessed initially around the time of mixing, with aggression continuing to occur around feeding events. In addition to causing acute and chronic stress, which can increase pregnancy losses, reduce litter sizes and birth weights and potentially affect post-natal performance and behavior of progeny, aggressive interactions can also lead to structural damage and the premature culling of sows. It is, therefore, important that strategies are developed which reduce negative interactions between sows, and can be easily implemented within commercial systems. It is also important that sows are provided with the opportunity to express positive natural behaviours, such as foraging and play.

Providing access to straw and other fibre sources can benefit group housed sows in a number of ways. The highest levels of aggression are witnessed around feeding as sows fight for limited resources. Straw increases the fibre content of feed, which alters gut transit time and the feeling of satiety. Sows fed high fibre pelleted diets have previously been shown to display reduced aggression (van Wettere, 2012). Straw also provides environmental enrichment in concrete/slatted pens. A reduction in pen exploratory behaviour has been observed in sows given access to straw racks (Stewart et al., 2008). This is thought to have occurred as sows with access to straw were given an outlet for foraging behaviour. Additionally, the provision of silage has been shown to alleviate stereotypies such as sham-chewing (O'Connell, 2007). Whilst these last investigations identified no difference in aggression, the sows were housed in dynamic groups and fed via electronic sow feeders. What is not known is whether continual access to a fibre source reduces physiological and behavioural indicators of stress in sows housed in stable groups during gestation. Also, the effects of providing a fibre source on reproduction have not been fully investigated. In this study we determined whether providing sows access to straw or hay in racks or no substrate affects sow behavior, aggression and reproductive output.

2. Methodology

A total of 890 sows were used in this experiment. Prior to the commencement of the trial, sows were housed as follows: weaned into groups of 30 and then housed in groups of 10 from weaning until pregnancy confirmation. During this time, sows were floor fed. After pregnancy confirmation, animals were allocated randomly to be housed in groups containing either an empty rack (Control; n = 299 sows), a rack filled with straw (STRAW; n = 301) or a rack filled with cereal hay (HAY; n = 290). Sows were mixed into groups on day 42.1 ± 0.16 (CONTROL), 42.4 ± 0.18 (STRAW) and 40.9 ± 0.18 (HAY) post-mating, and fed via fitmix electronic sow feeders (ESF).

There were two racks per pen (~ 60 sows / pen), with racks filled daily with 200g of substrate / sow / day. Each sow was allowed 2.1 kg/d of dry feed via the ESF system.

Sows were weighed and P2 backfat recorded at entry and exit (day 110 gestation) from the pens, with litter size data recorded for 203, 231 and 224 sows from the CONTROL, STRAW and HAY treatments, respectively. The following measurements were collected: total litter size, the number of piglets born alive and dead, the number of mummified fetuses, the number of piglets dying in the first 24 hours post-partum, litter size after fostering, piglet mortality from cross fostering to weaning, and the number of piglets weaned. Reasons for removing sows from the pens were recorded. Within each treatment, there were 75 focus sows, from which scratch scores, injury scores and locomotion scores were determined on the day prior to mixing and on days 2 and 30 days after mixing. Specifically, each sow was allocated a subjective scratch score for the head, body and rump. The sow received a score of zero if there were no scratches present, a score of one if there were one to five scratches, a score of two if there were six to ten scratches, and a score of three if there were greater than 11 scratches present for each of the three body sections. Locomotion or lameness was scored whilst the sow walked (after at least a distance of 20 m). A score of zero was given when ability to stand was unaffected and all legs bore weight similarly, one if the sow was not considered lame but movement was compromised, two if the sow was moderately lame and its ability to stand was obviously reduced. A score of three represented a severely lame sow whose ability to stand and move was severely restricted. Sow behavior was recorded by analysis of 4-hour video recordings collected on days 2, 9 and 30 post-mixing. The behaviours recorded are described in Table 1. As duration of behaviour could not be coded, due to the number of animals in a pen making accuracy of this measure difficult, behaviours were coded again after 10 seconds if they were still being exhibited. Therefore, to get an idea of the duration of exploration we can multiply the number of times the behavior was coded by 10 seconds. This method is obviously limited, as it is not an exact value and exploration duration may be less than this figure, but this figure is the upper limit for the time spent exploring by the sows and allows us a reference to interpret the data. We have used this figure only for exploration, which will be close to this duration if this measure is used (as they were often coded on numerous occasions) but not for fights (which very rarely went over 10 seconds).

Table 1 Ethogram used to define and record behaviours*

Behaviour	Definition
Eating	Sow classed as eating if she entered into the feeder with her full head and shoulders in the protected shoulder stall area of the ESF.
Fighting	Any bout of aggression which lasted for 3 or more seconds and involved several knocks and / or bites
Knock	One sow knocks another sow using her head and neck, contacting any part of the receiving sow
Bite	One single bite delivered from one sow to any part of another
Flee	Sow moves herself quickly and as far away as she can get from another sow, in response to an aggressive action

Mount	One sow mounts another, with her front legs both over the back of the other animal
Displace	Movement of one sow by another from a valued resource such as food, drinker, or lying space, with minimal aggression required (if multiple knocks or bites are required, this is a fight)
Guarding rack or substrate	Any form of aggression (knock, bite, lunge) or a defensive posturing with no aggression needed, in order to stop other sows from reaching a valued resource. This behaviour could fall under displacement or fight if it fit into the below description, but was also specifically coded separately, in order to allow analysis of any aggression surrounding the rack and substrate.
Exploring	Actively manipulating a material, such as rooting, nosing, moving or chewing the material (exploration was coded for rack, substrate outside of rack such as on the floor and pen work)
Play	All locomotor and object play were included in one overall heading of 'play'. Locomotor play included running, hopping, pivots and head tossing. Object play is when an animal manipulates an item or securely holds it in its mouth, energetically shaking it (Newberry *et al.* 1988). Object play is play specifically directed towards something, to allow analysis of play around/ using the enrichment.

All behaviours coded as point event. If behaviour was exhibited for 10 seconds or more, the behaviour was coded again.

Statistical analysis

Before analysis, data were checked for normality by examining the distribution of residual plots. When data is provided, the transformation is specified. Behaviour data, scratch scores, injury scores and locomotion scores were analyzed using the Statistics Package for the Social Sciences (SPSS) version 24.0 (IBM, Armonk, NY) using a general linear mixed model. Measures are taken per sow (for e.g., total born and injury scores) and then averaged per pen, to allow analysis as pen as the unit. Day of measure, and treatment and the interaction between the two were fitted as fixed effects and entry weight and day -1 measures (when applicable) as covariates. Pen and group were fitted as random effects (pen: a number given to the specific pen used to allow for variation in housing, a single pen was used more than once, group: a number given to each individual group of animals which came through the experiment, this was not repeated, all groups were different). Where transformations occurred, non-transformed adjusted means are presented for clarification. Scratch scores and injury scores were unaffected by treatment or day, and therefore only non-transformed data is presented. Data are expressed as least squares means ± SEM and a difference at $P < 0.05$ was deemed significant.

An unbalanced analysis of variance (ANOVA) model was used to compare the effects of treatment on sow body composition and reproductive output (Genstat 15th Edition). Weight gain and P2 gain were included as co-variates in the model when analyzing treatment effects on litter size data and piglet mortality. The effect of treatment on the proportion of sows removed for failing to eat from the ESF was determined by chi-squared analysis.

3. Outcomes

There were no effects of treatment on incidences of aggression. However, the incidence of guarding behavior exhibited was higher in the HAY compared with CONTROL and STRAW treatments (Table 2). There was also a significant effect of treatment on the incidence of rack and loose substrate exploration, as well as the duration of rack exploration (Table 2). Fight number was highest on day 2 compared to days 9 and 30 (Table 3), with the incidence of rack and substrate guarding also decreasing after day 2 (Table 3). Total scratch scores were 5.97 ± 0.44, 4.97 ± 0.39 and 5.03 ± 0.39 for CONTROL, HAY and STRAW sows, respectively ($P = 0.204$). Total injury scores were 0.22 ± 0.16, 0.297 ± 0.14 and 0.54 ± 0.142 for CONTROL, HAY and STRAW sows, respectively ($P = 0.259$). Total scratch scores and injury scores were unaffected by day relative to grouping: 5.35 ± 0.31 and 0.35 ± 0.09 (day 2) and 5.30 ± 0.31 and 0.30 ± 0.06 on day 30, respectively. There was an interaction between day and treatment for both guarding behavior and exploration of 'enrichment' (rack and associated substrate). Regardless of day relative to grouping, guarding behavior was always highest in the HAY treatments (Figure 1). However, whilst exploration behavior was higher in HAY compared with both STRAW and CONTROL on day 2 post-grouping, exploration behavior was highest in the STRAW treatments compared to both CONTROL and HAY on days 9 and 30 post-grouping (Figure 2). Interestingly, there was a significant decrease in the use of hay on day 30, but this same decrease in use was not seen with straw (Figure 2). This may suggest that the straw could be a better substrate for long term maintenance of interest than the hay. There was an interaction ($P < 0.05$) between day and treatment for locomotion scores (Figure 3). On day 30, locomotion scores were lower in the HAY compared with CONTROL and STRAW treatments. Locomotion scores were lower on day 30 compared with day 2 in the HAY treatment (0.017 ± 0.052 versus 0.173 ± 0.052), but were similar on day 30 and day 2 in both the CONTROL and STRAW treatments (Figure 3).

The proportion of sows removed from the ESF pens tended to be lower ($P < 0.1$) for the HAY compared with CONTROL treatment (15% versus 21%) and was significantly lower ($P <0.01$) in the STRAW compared with CONTROL treatment (12% versus 21%). Weight gain was higher for the sows in the CONTROL and HAY compared with STRAW treatments: 26.6 ± 1.37 and 24.9 ± 1.30 versus 17.8 ± 1.28, $P = 0.016$. Sows in the STRAW treatment gained less P2 backfat compared with those in the HAY treatment ($P < 0.01$); -0.07 ± 0.28 versus 1.45 ± 0.28 mm.

Total litter size and the number of stillborn piglets were higher in the STRAW compared with CONTROL treatment (Table 4). The number of live born piglets was unaffected by treatment; however, the number of mummified fetuses per litter was significantly higher for the STRAW and HAY compared with CONTROL treatments (P < 0.01). Farrowing rate was 87%, and was unaffected by treatment. Following group formation, 0% (CONTROL), 0.7% (STRAW) and 0.7% (HAY) of sows were removed for not being in pig. The number of piglets dying within 24 hours of parturition and between day one post-partum and weaning was unaffected by treatment, nor was the number of piglets weaned per litter (Table 4).

Table 2 Effect of Treatment on incidence of guarding behaviour towards racks and substrate, and incidence and duration of exploring rack and substrate. Transformed data (Mean ± SEM) presented with non-transformed means presented in brackets

Behaviour	Treatment			*P Value*
	CONTROL	HAY	STRAW	
Guarding rack and substrate	0.01±0.17 (0.84)	0.61 ± 0.02 (17.29)	0.02 ± 0.16 (-0.09)	< *0.05*
Exploring rack and substrate	0.00±0.21 (2.17)	0.63 ± 0.19 (80.35)	1.22 ± 0.18 (29.33)	< *0.01*
Maximum exploring rack and loose substrate duration (seconds)	-0.04±2.13 (21.74)	6.32 ± 1.89 (803.49)	12.24± 1.84 (293.33)	< *0.01*
% Maximum time spent exploring rack and loose substrate (Max. duration / 14400 sec)	0.15	5.58	2.04	

Table 3. Effect of Day post-mixing on fight number and guarding behaviour towards racks and substrate. Transformed data (Mean ± SEM) presented with non-transformed means presented in brackets.

Behaviour	Day post-mixing			*P Value*
	2	9	30	
Fight Number	2.3 ± 0.25 (6.96)	0.5 ± 0.25 (0.72)	0.2 ± 0.24 (0.20)	< *0.01*
Guarding rack and substrate	0.37 ± 0.11 (15.41)	0.14 ± 0.11 (1.37)	0.13 ± 0.11 (1.26)	< *0.01*
Explore rack and substrate	0.82 ± 0.17 (88.36)	0.59 ± 0.17 (14.39)	0.44 ± 0.17 (9.11)	> *0.05*
Maximum exploring rack and loose substrate duration (seconds)	8.2 ± 1.7 (883.60)	5.9 ± 1.7 (143.90)	4.4 ± 1.7 (91.07)	> *0.05*
% Maximum time spent exploring rack and loose substrate (Max. duration / 14400 sec)	6.13%	0.99%	0.63%	> *0.05*

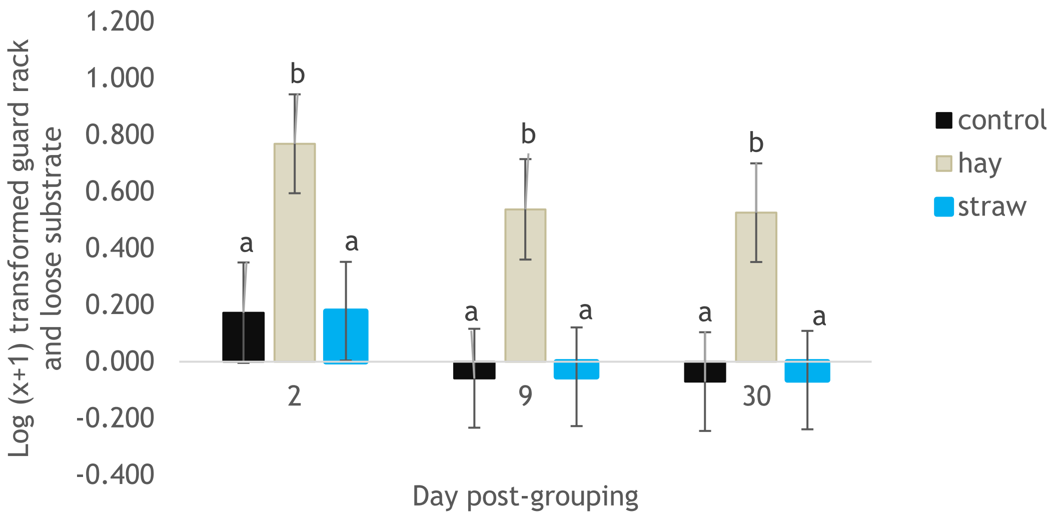

Figure 1 Effect of substrate (Control versus Straw versus Hay) on guarding behaviours on days 2, 9 and 30 post-grouping ([ab]within day indicates difference; P < 0.05)

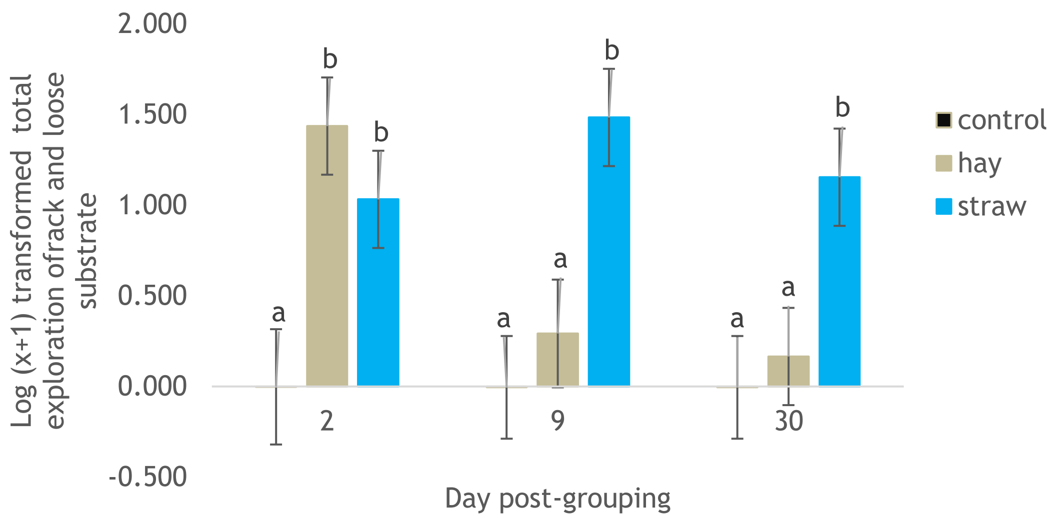

Figure 2 Effect of substrate (Control versus Straw versus Hay) on exploration of enrichment on days 2, 9 and 30 post-grouping ([ab] within day indicates difference; P < 0.05)

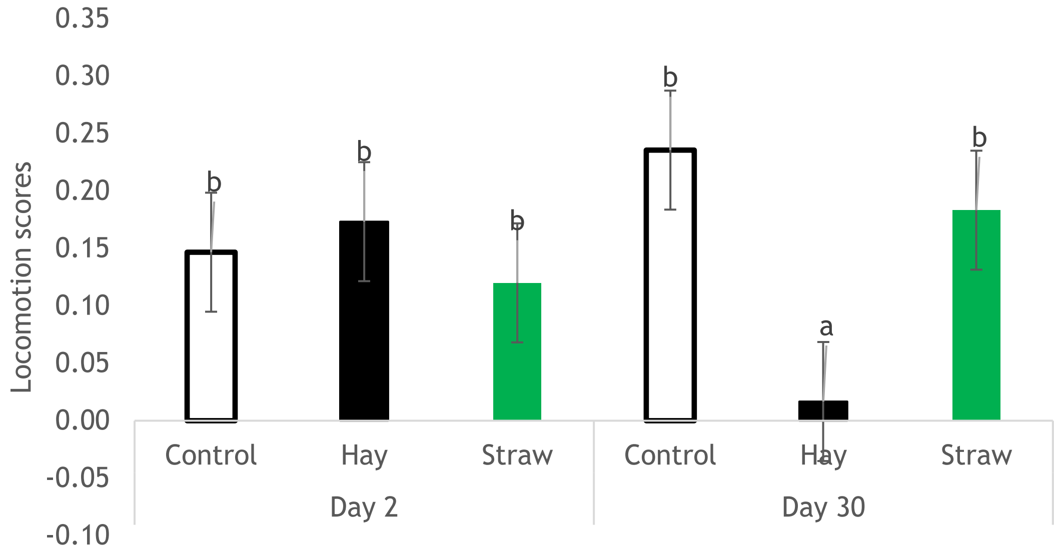

Figure 3 Effect of substrate (Control versus Straw versus Hay) on locomotion scores on days 2 and 30 post-grouping ([ab] indicates difference; P < 0.05)

Table 4 Effect of treatment on reproductive performance of sows

Variable	Treatment			*P Value*
	CONTROL	HAY	STRAW	
Gestation length	116.1 ± 0.10	115.9 ± 0.10	116.1 ± 0.09	*0.352*
Total born	12.77 ± 0.22	12.97 ± 0.21	13.51 ± 0.21	*0.038*
Born alive	11.95 ± 0.12	11.94 ± 0.19	12.18 ± 0.19	*0.603*
Still born	0.72 ± 0.09	0.84 ± 0.08	1.10 ± 0.08	*0.007*
Mummified fetuses	0.09 ± 0.03	0.21 ± 0.03	0.23 ± 0.03	*0.006*
Piglet mortality < 24 hrs	0.64 ± 0.07	0.59 ± 0.06	0.52 ± 0.06	*0.412*
Litter size day one	11.30 ± 0.09	11.54 ± 0.08	11.40 ± 0.08	*0.137*
Piglet mortality d 1 – wean	1.05 ± 0.10	0.89 ± 0.10	0.86 ± 0.09	*0.347*
Pre-wean mortality, total	1.68 ± 0.13	1.47 ± 0.12	1.38 ± 0.12	*0.205*
Litter size weaned	9.36 ± 0.16	9.41 ± 0.15	9.07 ± 0.15	*0.248*

When results were analyzed based on gestation length (Short < 115 days; Average 115 and 116 days; or long > 116 days), effects on litter size and piglet mortality were observed (Table 5). Sows with a long gestation length gave birth to fewer total pigs compared with those with a normal and short gestation length ($P < 0.05$), and fewer live born piglets compared with sows with an average gestation length ($P < 0.05$). However, the number of stillborn piglets tended ($P = 0.89$) to be highest in sows with a short gestation length, whereas sows with a long gestation length expelled significantly fewer mummified fetuses ($P < 0.05$). Piglet mortality within the first 24 hours post-partum and between day 1 and weaning was significantly higher for sows with short gestations compared with both normal and long durations ($P < 0.05$). Sows with short gestation weaned fewer ($P = 0.108$) piglets than those with normal of long gestations; despite having similar suckling loads after cross-fostering.

Table 5 Effect of gestation length on litter size and piglet mortality

Variable	Gestation length		
	Short (< 115 days)	Normal (115 and 116 days)	Long (> 116 days)
No. sows	79	331	248
Total litter size	13.27 ± 0.35^{b}	13.48 ± 0.17^{b}	12.54 ± 0.20^{a}
Born Alive	11.95 ± 0.32^{ab}	12.34 ± 0.15^{b}	11.65 ± 0.18^{a}
Stillborn	$1.09 \pm 0.14^{*}$	$0.93 \pm 0.07^{*}$	$0.77 \pm 0.08^{*}$
Mummies	0.23 ± 0.05^{b}	0.21 ± 0.03^{b}	0.12 ± 0.03^{a}
Litter size day 1	11.56 ± 0.14	11.44 ± 0.07	11.35 ± 0.08
Piglet mortality			
< 24 hours post-partum	0.89 ± 0.11^{b}	0.62 ± 0.05^{a}	0.43 ± 0.06^{a}
Day 1 to weaning	1.70 ± 0.16^{b}	0.89 ± 0.08^{a}	0.73 ± 0.09^{a}
Birth to weaning	2.55 ± 0.19^{c}	1.51 ± 0.10^{b}	1.16 ± 0.11^{a}
Litter size weaned	8.78 ± 0.25	9.30 ± 0.12	9.40 ± 0.14

Within row superscripts indicate differences between means; ^{abc} $P < 0.05$; * $P = 0.09$

4. Application of Research

Overall the current data demonstrated no reduction in aggression, injuries, and scratches when group housed sows were provided access to either straw or cereal hay in racks. The current data does provide evidence that sows place a higher value on cereal hay as an enrichment source, based on time spent guarding (on days 2, 9 and 30) and exploring the resource (on day 2). However, exploration behavior directed at the racks and associated substrate was higher in the STRAW treatment on days 9 and 30 post-grouping, potentially indicating greater long-term interest amongst the sows. Alternatively, straw being less palatable may have represented a malleable substrate as opposed to being consumed rapidly (e.g. Hay). Unfortunately, it was not possible to determine definitively whether access to straw or hay resulted in sows spending less time near the feeders. However, the increased time spent exploring the substrate combined with the reduction in the proportion of sows removed for not eating from the ESF system used; indicate that substrate provision may have reduced competition around the feeder, allowing less dominant sows better access. This is supported, at least in part, by the reduced weight gain observed in sows with access to STRAW. Overall sow soundness was good regardless of treatment (as indicated by low locomotion scores overall); however, incidences of lameness were lower on day 30 post-mixing in the HAY treatment.

From a purely reproductive perspective, there are two interesting treatment related outcomes from this study. The first is the elevated stillbirth rates observed in the STRAW treatment compared with the HAY and CONTROL treatment. It is unclear from the current data whether this reflects impaired metabolic status of STRAW sows (as indicated by a reduction in weight gain), resulting in reduced piglet viability at birth or is merely a reflection of the higher total litter size of these animals. Regardless, the impact of providing sows access to straw during gestation on piglet birthweight appears warranted. It would also be logical to investigate whether the nutritional composition of the diets provided to sows with access to straw needs to adjustment to accommodate a potential reduction in intake. The second interesting outcome is that provision of both substrates resulted in a higher number of mummified fetuses. Although the absolute increases compared with the CONTROL treatment was low (0.1 of a fetus), this increase may reflect the presence of mycotoxins in the hay or straw. This suggests that maybe the inclusion of anti-mycotoxin agents be investigated when considering the use of forage within gestating sow systems.

Although not a primary objective of the study, the effects of gestation length on piglet survival were also analysed. Published data on Australian herds is sparse (non-existent); however, European studies have demonstrated that short gestation lengths are associated with increased stillbirths and pre-weaning mortality (Vanderhaughe et al., 2011). This reduced survival is due to reduced piglet maturity at onset of parturition (Zaleski and Hacker, 1993) and longer farrowing durations (van Dijk et al., 2005). Somewhat surprisingly, the current data demonstrate no effect of shorter gestation lengths on total litter size; however, total litter sizes were lower for sows with gestation lengths in excess of 116 days. Importantly, incidences of stillbirths tended to be higher, and significantly fewer piglets survived to weaning when sows farrowed prior to day 115 of gestation, supporting previous evidence of reduced viability and developmental maturity at birth. In total 12%, of sows fell into the category. These animals lost on average one extra piglet a litter prior to weaning. For a 1,000 sow breeding unit, producing 2.4 litters / sow / year this represents a loss of approximately 288 piglets per year (in excess of animals with normal gestation lengths). Given the association between earlier farrowing and developmental maturity, it might also be interesting to see how pigs from these animals fared after weaning. Commercially, this is an interesting outcome as it emphasizes the need to focus more attention on the management of early born piglets and the need to develop strategies to prevent premature farrowing. Of particular concern would be batch-farrowing systems as the options to cross foster these potentially more vulnerable piglets are reduced due to lack of available foster sows.

5. Conclusion

Providing group-housed sows with access to foraging substrates in racks did not appear to reduce aggression. However, access to hay in racks resulted in reduced lameness on day 30 post-grouping, and increased guarding behavior (indicating its value to the sows). Access to straw in the racks appeared to maintain sows interest for longer relative to grouping, as evidenced from the increased exploration of the racks and associated substrate on days 9 and 30 post-grouping. However, it is possible this represents differences in the function of straw and hay, with straw potentially representing a malleable substrate and hay a nutritional source. Regardless, the increased time spent exploring the racks and substrates combined with the reduced incidence of sows which failed to use the ESFs for the first three days post-grouping may indicate that foraging substrates are beneficial for group housed sows, reducing competition for feeder access and potentially encouraging more submissive sows to use the feeders. In other words, it is possible that providing these two substrates reduced the importance placed on the ESF by sows as a resource. Based on guarding and exploration behavior it would appear that sows value cereal hay more highly than straw, suggesting it may be a more suitable nutritional enrichment substrate. However, the value of straw cannot be due to its ability to maintain sows interest for extended periods and for longer relative to grouping, as well as its potential to reduce competition associated with feeder access. In summary, both substrates appear to be valuable sources of enrichment.

6. Limitations/Risks

The limitation to these data is that they were generated from sows re-mixed into new groups on day 40 of gestation, and therefore the beneficial effects of providing substrate to sows grouped earlier in gestation or grouped for the first time requires further investigation. However, the patterns of aggression relative to grouping appeared similar in this study to what has been reported for sows mixed into groups post-weaning or insemination.

7. Recommendations

As a result of the outcomes in this study the following recommendations have been made:

- Substrates studied presently do little to reduce the incidence of sow aggression
- The capacity of effluent systems to cope with any substrate should be considered prior to implementation
- Cereal hay appears to be a more valued substrate, with the lack of an effect on weight gain indicating no negative effects on nutrient intake, and reduced incidence of lameness potentially indicative of reduced fighting.
- After day 2 post-grouping, sows spent more time interacting with the straw (either in the rack or on the floor around the rack) suggesting it may encourage forage related behavior; whereas hay was consumed rapidly and acted more as a source of nutritional enrichment.
- The provision of substrates may be drawing more dominant sows away from the ESFs resulting in greater use by more submissive sows, and a reduced incidence of non-eaters
- The impacts of substrate provision on consumption of concentrate diet from ESF should be investigated, as should the composition of diets used in conjunction with forage based enrichments
- Further work should determine in more detail the impact of providing forage substrates as enrichment on concentrate consumption as well as piglet birthweight and viability (particularly when the substrate is straw)
- Further work into strategies to prevent early farrowing are also warranted, as they contribute significantly to improving piglet survival to weaning.

8. References

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Appendix 1 - Notes

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Appendices

Appendix 1: