Title: The impact of routine piglet processing on well-being - **NPB# 04-043**

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Abstract: Soon after birth, piglets undergo procedures that are a likely source of stress. The aim of the first experiment was to evaluate stress responses evoked by two alternative methods for performing the following processing procedures: 1) teeth resection (TR) – clip vs. grind; 2) tail-docking (TD) – cold vs. hot-clip; 3) identification (ID) – ear notch vs. tag; 4) iron administration (FE) – inject vs. oral; 5) castration (CA) – cords cut vs. torn. Eight to ten litters of eight, 2-3 day-old piglets were assigned to each procedure. Within each litter 2 piglets were assigned to 1 of 4 possible procedures: the two alternative methods, a sham procedure, and a sham procedure plus blood sampling. Blood was sampled before processing and at 45 min, 4h, 48h, 1wk, and 2wks post-procedure and assayed for cortisol and beta-endorphin. Procedures were video-taped and analyzed to evaluate the time taken to perform the procedure and the number of squeals, grunts and escape attempts. Piglets were weighed before the procedure and at 24h, 48h, 1wk and 2wks afterwards. Lesions were scored on a 0 to 5 scale on ID, TD and CA pigs at 24h, 1 wk and 2wks post-procedure. For TR, grinding took about 20s longer than clipping and resulted in higher cortisol levels overall, poorer growth rates, more escape attempts and longer vocalizations ($P<0.05$). For TD, hot clipping took longer ($P<0.05$) and resulted in more, longer and higher frequency squealing ($P<0.001$) and more neuromas ($P<0.05$). For FE, oral delivery took longer and resulted in more squealing ($P<0.05$). For ID, notching took longer, resulted in higher lesion scores ($P<0.05$), more, higher frequency squealing ($P<0.001$), more escape attempts ($P<0.01$) and tended to result in higher cortisol concentrations ($P<0.1$). For CA, tearing took longer and resulted in more squealing and escape attempts ($P<0.05$). The aim of our second experiment was to compare a combination of the five different procedures. Comparisons were made between processing pigs with the 'most' aversive methods and the 'least' aversive methods. The same two control groups were included and the same parameters as experiment 1 were measured. A total of 8 pigs from each of 10 litters were used - one male and one female pig per treatment. Body weight did not differ between treatments ($P>0.1$). Females did not differ in their plasma cortisol response to processing ($P>0.1$). In contrast, male pigs in both the Most and Least

treatments exhibited elevated plasma cortisol at 45 min after processing as compared to Control pigs ($P<0.001$). Pigs in the Most treatment performed more squeals as compared to the Least ($P<0.01$) and the two control treatments ($P<0.001$). Pigs in the Least treatment performed more squeals than in the two control treatments ($P<0.07$). However, when adjusted for the amount of time required to perform the two treatments, no treatment differences were noted ($P>0.1$). These data indicate that both the Most and Least processing approaches reported in this study result in robust stress responses. In addition, the time required to perform procedures contributes significantly to the stress experienced by the pigs. Future work to qualify measures of stress during these procedures may be beneficial.

Introduction: Routine production procedures, for example teeth clipping, tail docking and castration, most likely cause pain and are under increasing scrutiny from the animal rights lobby. Although research investigating the effects of individual processing procedures on piglet behavior, health and well-being has previously been published there are no data available that describe the cumulative effects of multiple procedures performed in a manner consistent with industry standards. The available data demonstrate that piglets can adapt to the relatively low, though not insignificant, levels of stress elicited by procedures performed separately. There are limits, however, to the ability of an animal to respond and adapt to stress and the true cost, in terms of loss in productivity and reduced well-being, of current processing approaches has not yet been evaluated. The proposed research evaluated the net effects of simultaneous processing akin to practices carried out in industry. This work also provided a systematic evaluation of the acute- and medium-term pain and stress responses, which will ensure that industry practices are being carried out from a position of sound scientific fact. The project also identified areas of future research that will enable producers to reduce the impact of the procedures on the pig and impart ancillary benefits to animal well-being and productivity.

Objectives:

1. To evaluate the cumulative stress response evoked by teeth-clipping, tail-docking, identification marking, iron-injecting and castration.
2. To identify practical approaches for further study that may reduce stress and improve piglet well-being and productivity.

Materials & Methods: This experiment investigated the short- to medium-term consequences of processing carried out at approximately 48 hours after birth on behavior, vocalizations, plasma stress hormone levels and pathological changes. In our first experiment examining the procedures carried out singly, data were collected on a total of 328 piglets from 45 litters according to the following design:

Teeth resection	Tail docking	Iron administration	Identification	Castration
10 litters – 8 piglets/litter	10 litters – 8 piglets/litter	8 litters – 8 piglets/litter	9 litters – 8 piglets/litter	8 litters – 4 piglets/litter
Clipped + bleed – 2 piglets/litter Ground + bleed – 2 piglets/litter Control + bleed – 2 piglets/litter Control – 2 piglets/litter	Cold clippers + bleed– 2 piglets/litter Hot iron + bleed – 2 piglets/litter Control + bleed – 2 piglets/litter Control – 2 piglets/litter	Injection + bleed – 2 piglets/litter Oral + bleed – 2 piglets/litter Control + bleed – 2 piglets/litter Control – 2 piglets/litter	Ear notched + bleed – 2 piglets/litter Ear tagged + bleed – 2 piglets/litter Control + bleed – 2 piglets/litter Control – 2 piglets/litter	Castrated with spermatic cords cut – 1 piglet per liiter Castrated with spermatic cords torn – 1 piglet per litter Control + bleed – 1 piglet/litter Control – 1 piglets/litter

In our second experiment examining the procedures carried out together, data were collected on a total of 80 piglets from 10 litters according to the following design:

Cumulative procedures
10 litters – 8 piglets/litter

- Teeth clipped, iron injected, ear tagged, cords cut, tails cold docked – 1 male piglet per litter
- Teeth ground, oral dosed, ears notched, cords torn, tails hot clipped – 1 male piglet per litter
- Teeth clipped, iron injected, ear tagged, tails cold docked – 1 female piglet per litter
- Teeth ground, oral dosed, ears notched, tails hot clipped – 1 female piglet per litter
- Control and bleed – 1male and 1 female piglet per litter
- Control – 1 male and 1 female piglet per litter

The control + bleed piglets were handled as if undergoing the procedure and blood sampled. The control piglets were handled only. This level of control enabled us to discriminate between the response to the processing procedure and any effects of the handling and blood sampling procedures. Litters were balanced across treatments for litter size and sow parity and piglets within treatment were balanced for gender and birth weight. Piglets underwent the assigned procedure at 2-3 days of age and the following parameters were measured.

Protocol
The litter of piglets was removed from the home pen into a 4-wheeled, solid-sided cart. The cart was then pushed out of the farrowing room to the central area between two wings of the building. Here, a selected piglet was marked with stock marker and had a blood sample taken by jugular venipuncture. It was then carried to an empty nursery room in the other wing of the building, where it was handed to the person responsible for the processing (always the same person). The processor then weighed the piglet and carried out the assigned procedure, with camcorder and sound capture software

running continuously. The piglet was then carried back to the middle room and replaced into the cart. The next piglet was then processed similarly, and so on until the full litter was completed. The cart was then pushed back to the home pen and the piglets placed back with the sow. Forty-five minutes and 4 hours post-processing, the piglets were removed in a similar fashion and blood sampled again. Sampling, weighing, pain tests and wound scoring also occurred at 24 hours, 48 hours, 1 week and 2 weeks post-processing.

Blood samples

Blood samples were collected by jugular venipunpcture. Samples were taken immediately before the procedure, then at 45 minutes, 4 hours, 48 hours, 1 week and 2 weeks post-procedure. Sampling was carried out by highly experienced personnel and a sample was normally obtained within 30 seconds of the piglet being picked up. Blood was analyzed to determine circulating cortisol and β-endorphin concentrations.

Behavior

All treatment and handling procedures were video-taped using a tripod-mounted camcorder. These were analyzed to determine the immediate behavioral response to the procedure using focal sampling. Behavior recorded included escape attempts and leg swings. During weighing, an escape attempt is defined as an attempt to jump off the weighing scale. During processing, an escape attempt is defined as a body movement carried out to affect an escape. Piglets often carry out a bout of sequential leg kicks in an attempt to escape, followed by a pause. We recorded both the number of bouts and the number of individual leg kicks within a bout. These video-recordings were also used to determine the number of grunts and squeals elicited during the procedures.

Vocalizations

Vocalizations were recorded during the procedures using a Beyer microphone connected directly to a Dell laptop computer running Raven 1.2.1 sound analysis software (Cornell University, Ithaca, NY). After capture, the vocalizations were analyzed to determine duration and peak frequency.

Lesion scoring

Lesion scoring was carried out on tail docked piglets and piglets undergoing the identification procedures, at 24 hours, 1 week and 2 weeks post-procedure. Lesions were measured for size and scored on a 0-5 scale:

0 Intact skin with no swelling or reddening, complete healing with no scab;
1 Swelling but intact skin or healing lesion with a scab;
2 Severe swelling but skin intact or a narrow, red, ulcerated wound round the perimeter of the injury site with little or no exudates, a healing lesion showing a large scab with underlying granulation;
3 Wider band of red, ulcerated skin surrounding injury site, but with no purulent exudates present;
4 Red, ulcerated lesion covered by purulent exudates, swelling of the surrounding tissues;
5 Large red, ulcerated lesion with much pus and exudates and a strong smell of necrosis, severe swelling.

Pain tests

Pain tests were carried out on tail-docked piglets at 3 days post-procedure. After lesion scoring, piglets were subjected to a formalin and an acetone stimulation test on the injury site. Behavior was video-recorded throughout procedures and for 15 minutes following testing and each piglet was focal sampled. Behavior recorded included time spent in different postures, time spent rooting, nosing, scratching tail on walls and with tail tucked. More specific behaviors such as, tail wags, escape attempts, leg swings and foot stamps were also recorded.

Weight

Piglets were weighed immediately before the procedure, then at 24 hours, 48 hours, 1 week and 2 weeks post-procedure to determine longer-term effects on growth.

Pathology

A subset of tail-docked animals were humanely euthanized at weaning. Body weight and individual organ weight (liver, spleen, and right adrenal gland) were recorded. The ratio of adrenal weight/body weight and ratio of adrenal cortex/medulla was analyzed. Left and right adrenal glands were fixed in 10% neutral formalin. Following fixation, the adrenal glands were embedded with paraffin, and 10 micrometer-thick sections were cut in the coronal plane through the glands. Every 6^{th} section from the left adrenal gland was stained using eosin/hemotoxilin stain and the ratio of adrenal cortex:medulla was calculated. Tail tissue samples were used to determine procedure-induced changes in neuronal terminals, such as neuroma, pain-related abnormal neuronal terminals, using histological straining, immunocytochemical staining and neuronal tracers.

Statistical methods

All data were checked for normality and homogeneity of variance and where necessary Box-Cox transformations were performed to determine an appropriate λ value for subsequent transforms. All data were analyzed in SAS (SAS V8.02). using Proc GLM. Where significant F values were noted appropriate post hoc tests (Tukey's) were performed to determine where these differences lay.

VI. RESULTS

Least aversive procedures compared to the most aversive procedures were determined in the five preliminary experiments using measures of physiology and behavior. With so much data being collected it was clear that some measures of distress would conflict with others in our assessment of the Least vs the Most aversive. Therefore, we used traditionally accepted measures of stress (high vocalization rate, elevated cortisol, depressed growth, and escape behavior) to form these categories. Based on these measures teeth grinding proved to be "most" aversive as compared to teeth clipping based on higher overall plasma cortisol concentration ($P<0.05$ - see Figure 1 and Table 1), higher β-endorphin concentration at 4 hours post-procedure ($P<0.05$), depressed growth rates ($P<0.1$ - see Table 1), increased escape behavior ($P<0.05$- see Table 1) and increased duration of vocalizations ($P<0.001$- see Table 1).

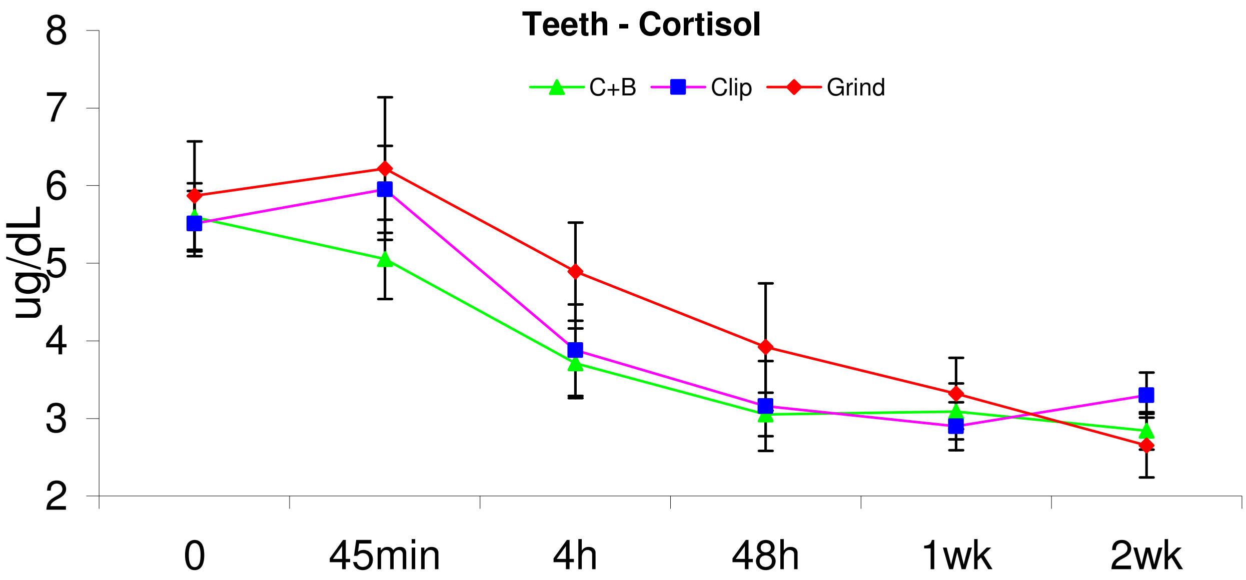

Figure 1: Plasma cortisol concentrations in piglets exposed to two methods of teeth resection and a handling and bleeding control.

For hot versus cold tail clipping, hot clipping was identified as 'most' aversive based on higher vocalization rates, increased frequency and duration of vocalizations (all P<0.05 - see Table 1). With identification procedures, ear notching was found to be 'most' aversive, based on increased escape behavior (P<0.01 - see Table 1), increased vocalization numbers (P<0.1 - see Table 1), worse lesion scores (P<0.05 - see Table 1), and higher peak frequency of vocalizations (P<0.05 – see Table 1 and for example see Figure 2). There were no treatment differences in the body weight and relative organ weight, including the liver, spleen, adrenal glands, and heart (P>0.05, respectively). However, there were differences in the ratio of adrenal cortex to adrenal medullar, which was in the order, controls> cold clip > hot clip (P<0.0005). Traumatic neuromas were found following both hot and cold clipping but the causes appeared to be different. Neuromas for the hot iron clipped piglets appeared to be derived from the clipping method. In contrast, cold clipped piglets had more tail damage from tail biting rather than the procedure, which was in the order, cold clipper cut piglets> hot iron cut piglets>controls, 100%, 50% and 25%, respectively. During pain tests, hot clipped piglets showed fewer (P<0.05) escape attempts (9.56±2.47) and more (P<0.05) foot stamps (5.55±3.12) than cold clipped (20.53±5.14 and 0.00±0.00) and control piglets (29.15±7.22 and 0.41±0.24). Control piglets also continued to engage in large amounts of tail-wagging, whereas clipped piglets did not.

For iron administration and castration, which were most difficult to categorize, oral dosing was classified as 'most' aversive based on vocalization numbers (P<0.05 - see Table 1), though there was no effect on vocal quality, and tearing was designated 'most' aversive again based primarily on vocalization numbers (P<0.05 - see Table 1). Numerically, mean frequency, peak frequency and call durations were all higher for tearing than cutting, but these were not significantly different. Another factor that was taken into account, in the categorization for these two techniques, was the time taken to carry out the technique. Oral dosing took longer than injecting (P<0.001 - see Table 1) and tearing took longer than cutting (P<0.001 - see Table 1). The impact of the time taken will be discussed below.

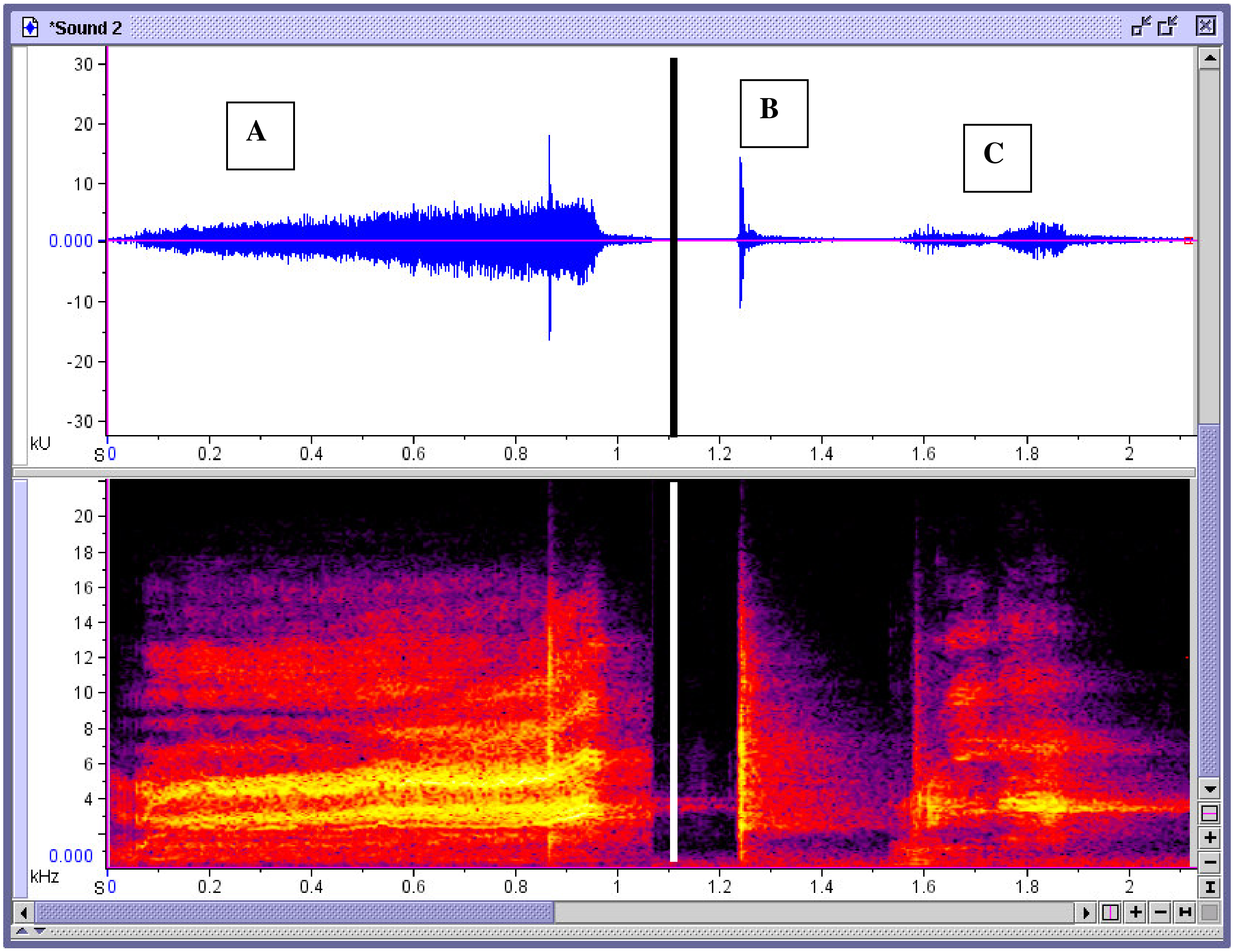

Figure 2: Example amplitude profiles and spectrograms from 2 piglets undergoing different identification techniques. A – squeal with ear notch included (notch made at sharp vertical line within vocalization – note increase in frequency power (yellow) after notching). B – tag inserted followed by C – squeal by piglet – note frequency power (yellow) lower than in A.

Table 1: Summary of significant results used in the determination of 'most' and 'least' aversive procedures when carried out singly

			Teeth Resection			
Measure	**Grind**	**Clip**	**Control + Bleed**	**Control**	**F-value**	**P-value**
Cortisol	4.48±0.11	4.12±0.08	3.89±0.09		7.35	0.015
B-endorphin						
Growth	4.67±0.27	5.22±0.19	5.38±0.23	5.39±0.25	2.85	0.056
Escapes	22.6±5.0	17.1±2.7	13.4±1.3	11.8±1.4	3.55	0.028
Vocal duration	0.72±0.11	0.56±0.08	0.46±0.10	0.40±0.07	6.57	0.001
Time to carry out	56.3±5.6	38.6±2.8	19.1±1.5	18.9±2.1	52.23	<0.001

			Tail Docking			
Measure	**Hot Clip**	**Cold Clip**	**Control + Bleed**	**Control**	**F-value**	**P-value**
Squeals	12.7±0.1	7.7±0.1	3.3±0.1	3.0±0.1	11.74	<0.001
Mean Vocal Frequency (Hz)	1912±241	1495±117	406±67	349±44	11.44	<0.001
Peak Vocal Frequency (Hz)	3365±127	3137±171	622±138	517±141	21.95	<0.001
Vocal duration (s)	0.46±0.08	0.37±0.07	0.26±0.04	0.27±0.04	4.63	0.007
Time to carry out	20.3±0.8	16.9±1.0	11.5±0.8	11.2±0.8	37.28	<0.001

			Identification			
Measure	**Ear notch**	**Ear Tag**	**Control + Bleed**	**Control**	**F-value**	**P-value**
Escapes	17.2±5.6	12.1±3.6	8.8±2.8	9.7±5.8	8.25	0.001
Squeals	19.9±3.7	10.2±4.8	11.6±4.0	7.9±5.2	15.42	<0.001
Grunts	11.6±8.1	7.1±4.7	6.2±4.4	7.8±3.8	2.66	0.071
1wk Lesion scores	2.0±0	1.1±0.6			16.79	0.003
2wk Lesion scores	0.7±0.2	0.3±0.1			6.40	0.035
Peak Vocal Frequency (Hz)	4269±121	3005±110	3020±98	3916±148	3.46	0.021
Time to carry out (s)	31.6±4.2	20.0±4.0	16.4±2.6	17.3±2.4	49.65	<0.001

			Iron Administration			
Measure	**Oral dose**	**Injection**	**Control + Bleed**	**Control**	**F-value**	**P-value**
Squeals	10.2±1.2	8.2±1.4	5.1±0.8	5.7±1.3	6.47	0.003
Grunts	8.3±1.3	6.1±1.2	5.0±0.8	4.6±0.7	3.13	0.047
Time to carry out	24.4±2.5	20.0±1.8	12.3±1.4	11.0±1.0	18.29	<0.001

			Castration			
Measure	**Tearing**	**Cutting**	**Control + Bleed**	**Control**	**F-value**	**P-value**
Squeals	63.9±9.3	43.5±7.0	15.2±2.7	15.7±1.3	15.85	<0.001
Grunts	27.1±7.5	18.4±3.8	6.9±2.0	5.0±1.1	5.65	0.0005
Time to carry out	96.1±11.0	70.1±5.5	21.1±2.7	18.4±1.9	32.80	<0.001

Having firstly categorized the procedures in isolation, our next experiment then examined the effects of adding the procedures together, i.e. carrying them out as most producers would as a single processing event, and comparing ‘most’ aversive techniques with ‘least’ aversive techniques as detailed above. Body weight did not differ between treatments ($P > 0.10$). Females did not differ in their plasma cortisol response to processing ($P > 0.10$). In contrast, male pigs in both the Most and Least treatments exhibited elevated plasma cortisol at 45 minutes after processing as compared to Control pigs ($P < 0.001$). Pigs in the Most treatment performed more squeals as compared to the Least ($P < 0.01$) and the two control treatments ($P < 0.001$). Pigs in the Least treatment performed more squeals than in the two control treatments ($P < 0.07$). However, when adjusted for the amount of time required to perform the two treatments, no treatment differences were noted ($P > 0.10$). Qualitative measures of vocal quality showed that the overall mean frequency of calls was numerically highest in the Most treatment (2000 Hz), intermediate in the Least treatment (1790 Hz) and lowest in the control + bleed (1390 Hz) and control (1402 Hz) treatments, although these values were not significantly different. Overall, peak frequency (see Figure 3) followed the trend Most > Least > Control+Bleed > Control, with Most being significantly higher at 3562 Hz than C+B (2735 Hz) and C (2405 Hz) treatments (both $P<0.05$).

Figure 3: Peak frequencies of vocalizations emitted during the cumulative processing procedures by piglets undergoing four different treatments.

In terms of lesions scores, there was no effect of Most or Least treatment on castration lesion scores, but both tail docking and identification lesions scores were significantly worse for the Most aversive treatment pigs at 1 wk post-procedure ($P<0.05$ and $P<0.1$ respectively).

Discussion: The major finding of this study is that the amount of time required to process the pig had a significant influence on measures of distress. In all cases where distinction between Most and Least aversive was relatively straightforward (such as teeth resection, tail docking and identification), the Most aversive treatment took significantly longer to carry out than the Least aversive treatment. For example, teeth grinding took an average of 56 s compared with 38 s for clipping. Notching took 32 s compared with 20 s for tagging. As the amount of time taken for the procedure to be carried out is likely to impact the amount of handling stress encountered by the piglet, the time taken to carry out the procedure then became an important measure in itself as to how aversive a procedure might be. Its impact is illustrated by the process of oral administration of iron falling into the “Most” aversive category when it was hypothesized that an injection would be more aversive. However, because the oral administration takes more time, the result to the pig is that it is more distressed by being handled and thus shows more distress. Oral dosing took 25% longer than injecting and likewise, gripping and tearing the spermatic cords took 37% longer than simply cutting the cords. However, in terms of productivity, all of the procedures, apart from grinding, were not stressful enough to cause a negative effect on body weight compared to handled control. This is not surprising because measures such as growth performance of piglets are fairly resistant to being influenced by distress. It would have been interesting to have a further non-handled control treatment for comparison.

With the pathology results, the reasons of reduction of adrenal glands, especially, adrenal cortex, were unclear. However, it could be similar to a finding in rats following heat stress. which reported that heat stressed rats had a significant increase in plasma corticotrophin (ACTH) and serum corticosterone (CORT) concentrations, with a reduced mass and volume of the adrenal glands, especially, the zona fasciculate of the cortex. Based on the neuroma data, tail docking gives rise to traumatic lesions which could cause chronic pain. However, a further study is needed to examine the changes of pain pathways and pain-related neuropeptides following tail docking. The pain tests would appear to show that stimulation of the tail results in inhibition of escape behavior and tail wagging and an increase in foot stamping in clipped piglets, especially those with tails removed by hot clipping, perhaps indicating greater pain sensitivity.

Taken singly, it was relatively easy to show that; a) one technique had advantages over the other and b) not subjecting the piglet to either technique also had some well-being advantages. However, when the procedures were added together, the differences between Most and Least were not so pronounced. In particular, we had expected to find greater effects on our physiological indicators of cortisol and beta-endorphin. Plasma beta-endorphin proved to be altered relatively little by any of the processing treatments used in these studies. However, their was a treatment by time interaction ($P<0.05$) in the comparison of teeth grinding compared to teeth clipping which indicated that grinding elevated beta-endorphin to a greater extent at 4 hours after processing. Beta-endorphin has a role in modulating pain, but it is also released whenever ACTH is released. As ACTH stimulates cortisol release, its increase in this case may just be as a 'side-effect' of the increase in cortisol production. We found that in the castration comparison, piglets that were castrated by cutting cord as opposed to tearing, tended to have ($P<0.1$) greater beta-endorphin at 45 minutes after processing, whereas there was no difference in cortisol response between the cut and tear treatments at this time point. In this instance, it may be that differences in the type of tissue damage being experienced are differentially stimulating beta-endorphin release through an unknown pathway. However, when we compared the combination of the "Least" and "Most" aversive measures all together we found no differences ($P>0.1$) in plasma beta-endorphin among the treatments and only treatment differences in cortisol in male pigs at 45 min post-processing. The disappearance of any effect on beta-endorphin may be due to a masking effect of a maximal stress response induced by the collective procedures, regardless of whether they are the 'least' or 'most' aversive.

Vocal quality appeared to be one of the more useful measures that were used in this study. Previous studies have looked at piglet vocalizations in relation to castration and isolation from the sow, and have shown, in general, that as distress increases (pain, in the case of castration and hunger, in the case of isolation), vocal quality changes, with increases in call duration and frequency. Our study also showed that certain other procedures influenced these measures. Perhaps not surprisingly, castration induced the highest frequency calls at 4.7 kHz and 4.4 kHz for tearing and cutting respectively, but ear notching also resulted in a mean peak frequency of 4.3 kHz, compared with only 3.0 kHz for ear tagging. From this measure alone, we can infer that ear notching is a relatively painful procedure, especially where certain litter and piglet numbers result in multiple notches being made in both ears.

Another interesting result to emerge from the tail-docking element was that traumatic neuromas were found in the tail stumps of pigs following both hot iron cutting and cold clipper cutting. However, there was greater damage, such as traumatic scars and formation of neuromas, in the piglets following hot iron cutting as compared to the tails of pigs cut by a cold clipper. Even more interestingly, cold clipped piglets had more tail damage from tail biting as compared to hot iron docked pigs which had more than nondocked controls; 100%, 50% and 25% exhibiting some level of damage, respectively. Morphological data suggest that tail docking is a stressor to piglet due to the presence of a traumatic lesion, which could cause chronic pain. Future research should focus on determining why pigs docked with a cold docking tool received more injury to the tail as compared to those docked with a hot clipper. In addition, further study is needed to examine the changes of the pain pathways and pain related neuropeptides in the piglets following tail docking to determine impact of neuromas on the pain sensation of the pig.

In summary, this study has identified methods of processing which, when applied singly, can be seen to have advantages over other methods in terms of piglet well-being. When applied collectively, the results are less clear, perhaps indicating that applying processing procedures collectively results in fairly maximal stress responses maybe due to the length of time taken to carry out the whole procedure on a young pig that has not had any previous experience of handling and separation from the sow and littermates. Further areas of study could investigate; a) whether the order in which the processes are applied has an impact on piglets' responses, b) whether carrying out procedures separately over several days may have a beneficial impact on piglets' responses, and c) whether an element of positive handling could be introduced over a few days prior to the procedures being carried out.

Lay Interpretation: The major finding of this research project is that any processing technique that can be carried out quickly and with minimal tissue damage is likely to be least stressful for the piglet. Alternative techniques such as teeth grinding, hot-iron tail-docking and oral dosing of iron, which might be expected to have some well-being advantages over teeth clipping, cold tail-docking and iron injecting respectively, were found to be disadvantageous primarily because of the amount of extra time needed to carry the procedure out. However, our alternative method of tagging for identification purposes, rather than ear-notching, did appear to improve piglet well-being, by being both a quicker technique and by greatly reducing tissue damage. Although subsequent loss of ear tags is a potential problem on-farm, tagging should be considered as a more welfare-friendly alternative. When carried out in a single processing event, our recommendation would be for all tasks to be carried out efficiently by a trained and experienced stockperson in order to minimize the time taken, ensure the accuracy of procedure and reduce the stress associated with the procedure itself and with the handling needed to carry out the procedure.

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