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Influence of pen design and space allowance on tail biting in weaning piglets

Previous trial setups already demonstrated the efficacy of enrichment materials and objects and an open water trough, installed in conventional pens of undocked weaners with simultaneously reduced stocking density. The behavioural disorder tail biting was significantly reduced by these measures. But the reduction of the stocking density is expensive and difficult to implement, especially for piglet producers. For this, the impact of space allowance on the occurrence of tail biting has been tested. In this experimental setup, conventional pens (one enrichment object, 0.35 m² per animal) were compared to affluent enriched pens with 0.5 m and 0.35 m² per animal. The results confirmed the positive effect of various enrichments on the development of tail biting. The differences of the frequencies of tail lesions between the enriched pens with normal and reduced stocking density proved to be low.

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pigs, tail biting, housing conditions, stocking density

Abstract
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Tail biting in pigs is a common problem that can lead to extreme animal suffering and economic losses. Docking the tails is considered to be the safest way to reduce tail biting [1; 2]. The EU Directive of 2001 on minimum standards for the protection of pigs, however, requires that a tail docking should not be done routinely [3]. Derogation could be approved for individual cases. On conventional farms in Germany, normally this possibility of exemption is applied, so that currently almost all conventionally produced piglets in Germany are tail-docked [4; 5].

According to numerous studies, the low-stimulus environment of modern animal husbandry systems is considered to be the main cause of tail biting [1; 6; 7; 8; 13].The high stocking density in conventional pig production is also suspected to have an influence on the outbreak of cannibalism [9; 10]. However, there are also studies in which the stocking density had no effect [11; 12].

A previous study of the Bavarian State Research Center for Agriculture (LfL) [13] showed, that by providing enrichment materials and objects in the pens and simultaneously reducing the stocking density, the frequency of heavy tail injuries in undocked rearing piglets was significantly reduced.

The reduction of the stocking density is a relatively high financial burden for the farmer, as it means either a reduction in the number of animals or an extension of the stable building. Providing about 50% more space in piglet rearing (0.5 instead of 0.35 m² per animal) costs up to € 3 more per piglet [14].

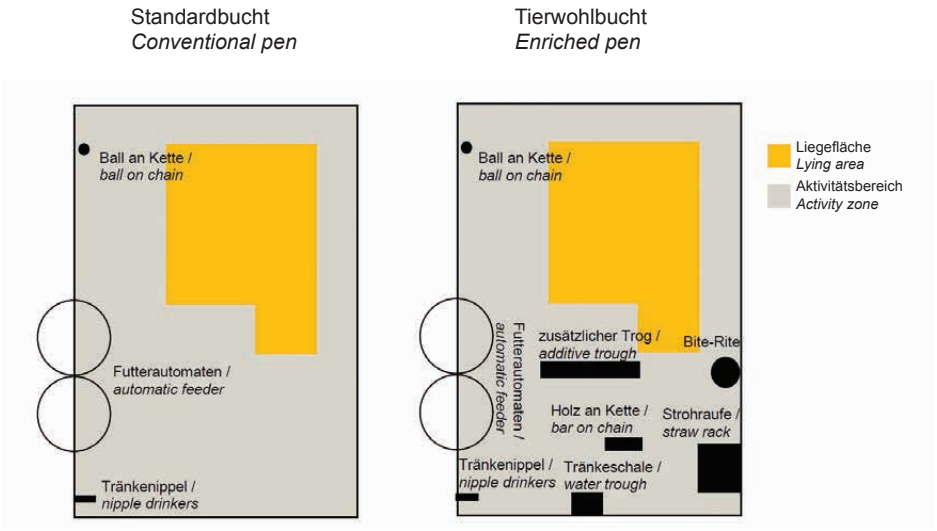
Therefore in the present experiment, the enriched pens should be tested with reduced stocking density (0.5 m² per animal) and with normal stocking density (0.35 m² per animal).

Materials and methods

Two trial runs were done with a duration of 6 weeks each. The experimental periods lasted from 13 June to 30 July 2013, and from 17 October to 3 December 2013. The trials took place in two identical barn compartments, each with four rearing pens. The pens had a size of 10 m² respectively, plastic slats, a closed lying area with underfloor heating, four feeding places at pulp feeding automates, three drinking nipples and a plastic ball fitted on a chain. Two of the eight pens were left in the original state as control version with 28 animals each. The other six pens were each equipped with a straw rack, a piece of wood on a chain fixed on the ground, a plastic cone with rubber rods ("Bite Rite") and an additional open water trough (aqua-level). In addition, Alfalfa was given from the start twice daily in an additional trough in these pens (**Figure 1**).

Three of the six enriched pens had a reduced stocking density with 20 animals each, the other three pens had 27 animals - for

Fig. 1



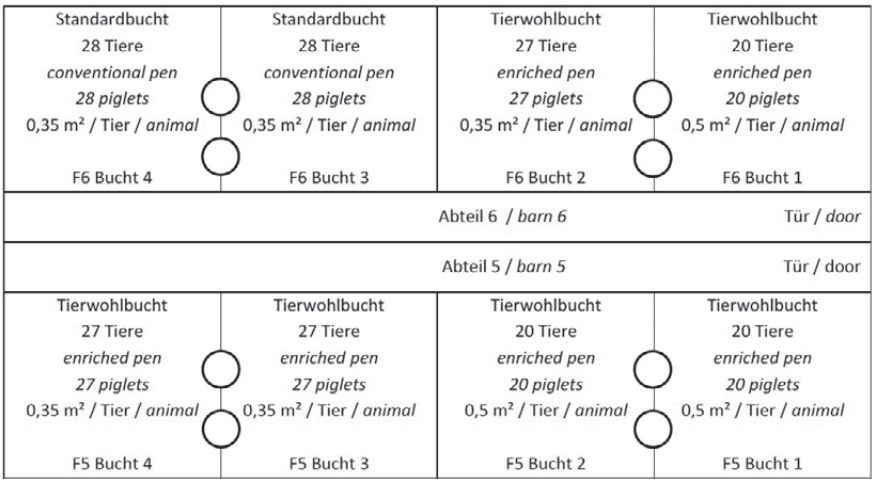
Plan views of the conventional pens and the enriched pens, both 10 m²

normal stocking density one animal was less than in the conventional pens, due to the space required for the straw rack. **Figure 2** shows the experimental setup of the first trial run. In the second run, the position of the enriched pens with 20 animals and 27 animals were replaced. In previous experiments it was observed, that the position of the conventional pens had no effect on the incidence of tail biting, so it was decided to leave the control pens in their original position. Also, mutual interference of adjacent pens could not be found. On an experimental version of the conventional pen with lower stocking density was omitted due to capacity. This will be tested in further experiments.

The litters were distributed to the rearing pens, that origin (mother), sex and live weight were spread as evenly as possible. The groups were compiled according to the weight at the age of 3 weeks. This was on average 6.9 kg in the first trial run and 6.8 kg in the second. All groups had the same average weight, the standard deviations within the groups were between 0.9 and 1.1 kg. The percentage of male and female piglets was up to 63 and 55%. The number of littermates per pen was maximum 4. The piglets in the pens were from 18 to 23 litters.

The animals were fitted with transponder eartags to collect individual data. They were weighed and registered individually at the age of 3 weeks in the farrowing stable to arrange the rearing groups from these data. In addition, the animals were weighted at the age of 4 weeks (weaning) and 10 weeks individually in order to document the weight gain. Twice a week,

Fig. 2



Experimental set-up in the two rearing barns in trial run 1

Table 1

Scoring scheme for tail lesions and partial losses

Schwanzverletzungen *Tail lesions*		**Teilverluste** *Partial losses*	
0	keine Verletzung erkennbar *no lesion visible*	0	kein Teilverlust *no partial loss*
1	Kratzer, leichte Bissspuren *scratches, slight bite marks*	1	bis zu 1/3 Teilverlust *up to 1/3 partial loss*
2	kleinflächige Verletzungen *small-area lesions*	2	bis zu 2/3 Teilverlust *up to 2/3 partial loss*
3	großflächige Verletzungen *large-area lesions*	3	mehr als 2/3 Teilverlust *more than 2/3 partial loss*

the piglets´ tails were individually evaluated by a scoring scheme which was developed in Schwarzenau [14]. It is a splitted scheme, that describes the state of the tail by the degree of injury (0–3) and the degree of partial losses (0–3) (**Table 1**).

Once a week, the feed and water consumption of two adjacent pens with the same experimental version were noted (compartment 5: pens 1 and 2 and also 3 and 4; compartment 6: pens 3 and 4). Thus, the feed and water consumption of two pens of each version was determined.

For the statistical analysis of the scoring, the chi-square test was used because the data were nominal. The frequencies of the scores in the respective experimental versions were compared over the entire experimental period. The chi-square test is robust to different sample sizes. To compare the daily weight gain of the animals (independent samples, numerical data), the differences between the mean values in the different trial versions were tested by a single factor variance analysis.

Results

Twice weekly the scoring of the tails was carried out. The differences between the pens within the experimental versions were only small (minor temporal shifts) so that all pens of one experimental version could be combined.

The animals in the conventional pens (**Figure 3**) began, as in the previous experiments (runs 1 to 4) [13], with strong tail-biting in the beginning of the second week after weaning. This led to a level of about 60% of stronger injured animals (notes 2 and 3). Counteractions were immediately initiated by feeding alfalfa twice daily until the end of the rearing period and removing a total of four persistent biting animals. This enabled an improvement of the situation, although this was lower than in previous trial runs [13]. The partial losses at the end of the rearing period affected mostly the last third of the tail. Only a small proportion of piglets had partial losses up to 2/3 of the tail. Partial losses of more than 2/3 of the tail did not occur in this trial version (**Table 2**).

The results of both experimental versions of the enriched pens (**Figure 4** and **5**) differed significantly from the results of the conventional pens (Chi²-test; $p < 0.001$). In both experimental versions, the incidence of injuries and partial losses was significantly lower. Stronger injuries (scores 2 and 3) only appeared later and were at the end of the rearing period at about 20%. The partial losses were also significantly lower. Only 5 resp. 6% of the piglets suffered a partial loss of the tail of less than 1/3, all remaining piglets kept their tail in its full length to the end of the trial (**Table 2**). The differences in the frequency of injuries between the two enriched versions were also highly significant (Chi²-test; $p < 0.001$), the frequencies of the partial losses had no statistical difference (**Table 2**).

The daily weight gain of the piglets were on average 477 grams in the conventional pens, 536 grams in the enriched pens with 20 animals and 498 grams in the enriched pens with 27 animals (**Figure 6**). The differences between all three versions were significant ($p < 0.05$).

The documented feed and water consumption in the six pens for both runs shows, that the animals consumed about 0.4 kg of feed per animal and day in the first week (**Figures 7** and **8**). In the second week, there was a sharp increase in the feed consumption of 0.6 up to 0.7 kg per animal and day. Subsequently, a continuous increase up to about 1.1 kg per animal and day took place. It can be clearly seen that the piglets in the enriched pens with 20 animals had the highest feed consumption, followed by the piglets in the enriched pens with 27 animals.

Water consumption per animal and day showed a similar trend (**Figure 8**). In the first week, the piglets consumed about

Table 2

Tail losses in the trial versions at the end of the weaning period

Versuchsvariante *Trial version*	**Teilverluste/***Partial losses*				
	kein *none*	**bis 1/3** *up to 1/3*	**bis 2/3** *up to 2/3*	**> 2/3** *> 2/3*	**Signifikanz**[1] *significance*
Standardbucht 0,35 m²/Tier *Conventional pen 0,35 m²/animal*	31 %	61 %	8 %	0 %	a
Tierwohlbucht 0,5 m²/Tier *Enriched pen 0,5 m²/animal*	96 %	4 %	0 %	0 %	b
Tierwohlbucht 0,35 m²/Tier *Enriched pen 0,35 m²/animal*	95 %	5 %	0 %	0 %	b

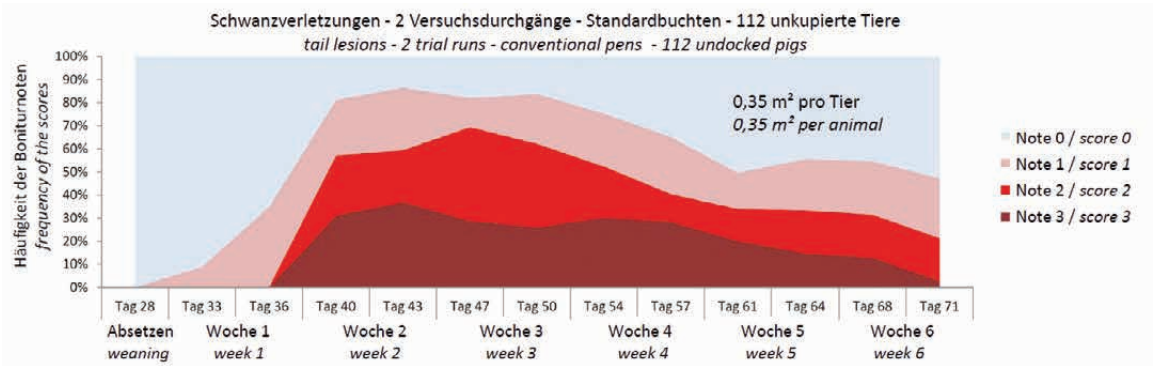
[1] Werte mit unterschiedlichen Buchstaben unterscheiden sich signifikant ($p < 5\%$)/*Values with different letters differ significantly ($p < 5\%$).*

1.5 liters of water, at the end of the rearing period it were up to 6 liters per animal and day. The piglets in the enriched pens with 20 animals clearly had the highest consumption, followed by the piglets in the enriched pens with 27 animals.

Discussion

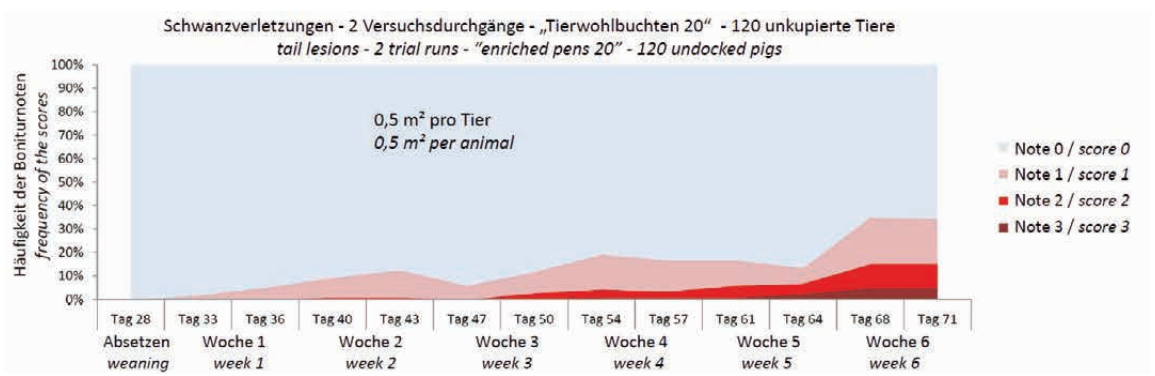
The results of the present experiments clearly show the effect of a pen with enrichment materials, roughage and additional open water trough on the intensity of the behavioral disorder tail biting. This experimental result confirmed the previous experiments with a remarkably high repeatability of the processes. In the conventional pens the animals began, also in the previous experiments, always within the first week after weaning with strong tail biting. The enriched pens with 20 animals, which were previously tested in two trial runs, showed again a delayed and significantly milder progress in tail biting [13].

Fig. 3



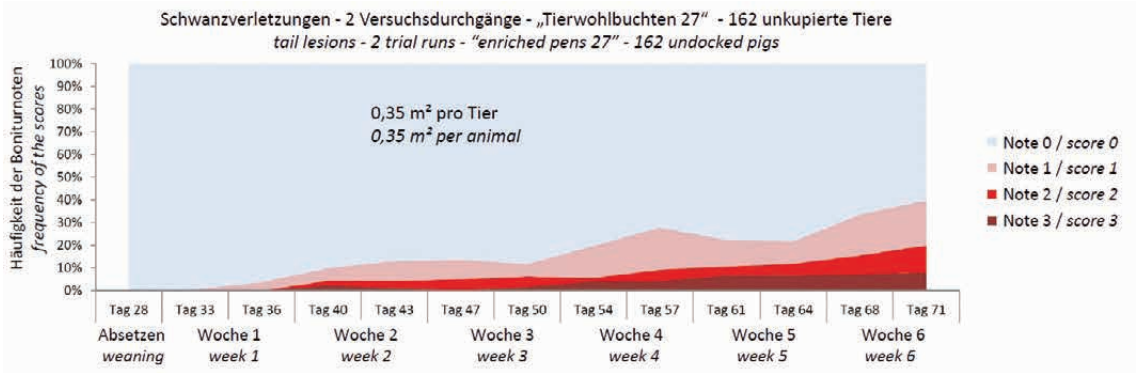
Tail lesions of undocked weaners in conventional pens in two trial runs (0 = no lesion; 1= slight bite marks; 2 = small-area lesions, 3 = large-area lesions)

Fig. 4



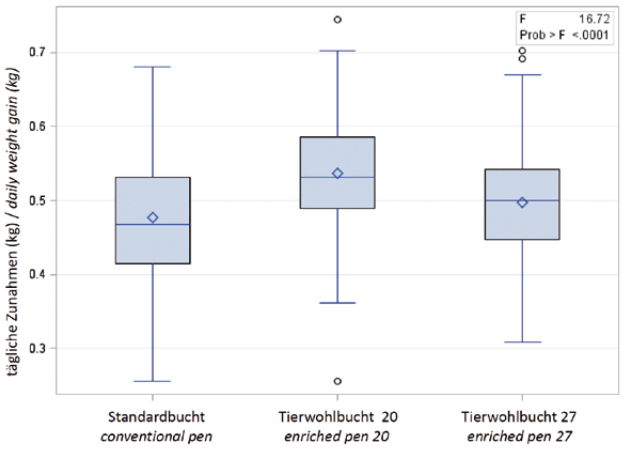
Tail lesions of undocked weaners in enriched pens with reduced stocking density in two trial runs (0 = no lesion; 1= slight bite marks; 2 = small-area lesions, 3 = large-area lesions)

Fig. 5



Tail lesions of undocked weaners in enriched pens in two trial runs (0 = no lesion; 1= slight bite marks; 2 = small-area lesions, 3 = large-area lesions)

Fig. 6

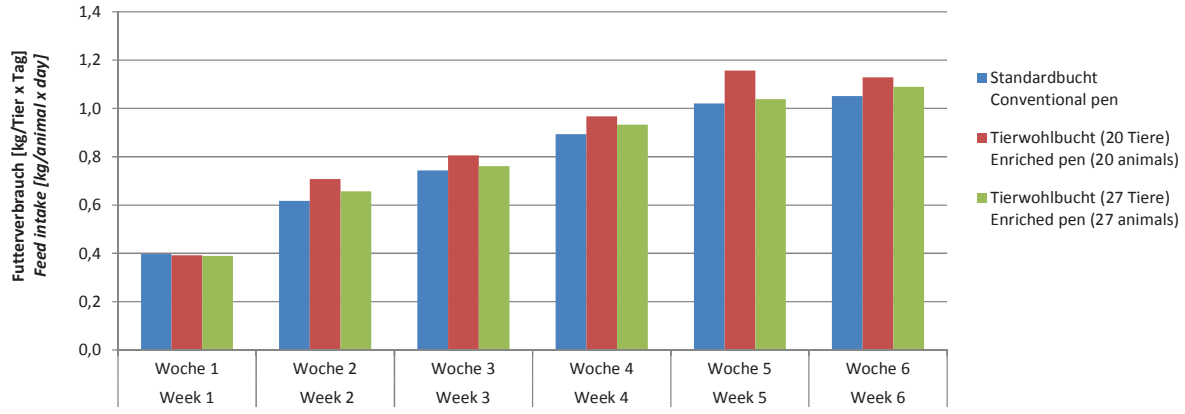


BoxPlot of the daily weight gains in the trial versions of both trial runs

The enriched pens with normal stocking density (0.35 m² per animal) had compared to enriched pens with reduced stocking density (0.5 m² per animal) only a slightly increased proportion of injury scores and only 1% more animals with a low-grade partial loss. Other studies concerning enrichment materials had also more positive results than experiments with the stocking density as influencing factor [1; 6; 7; 8; 13]. This suggests, that the enrichment of the pens in this experiment, had a significantly higher influence on the scale and the time of occurrence of tail biting than the stocking density. However, in order to judge this finally, the study of the conventional pens with reduced stocking density is missing. This is planned in further studies.

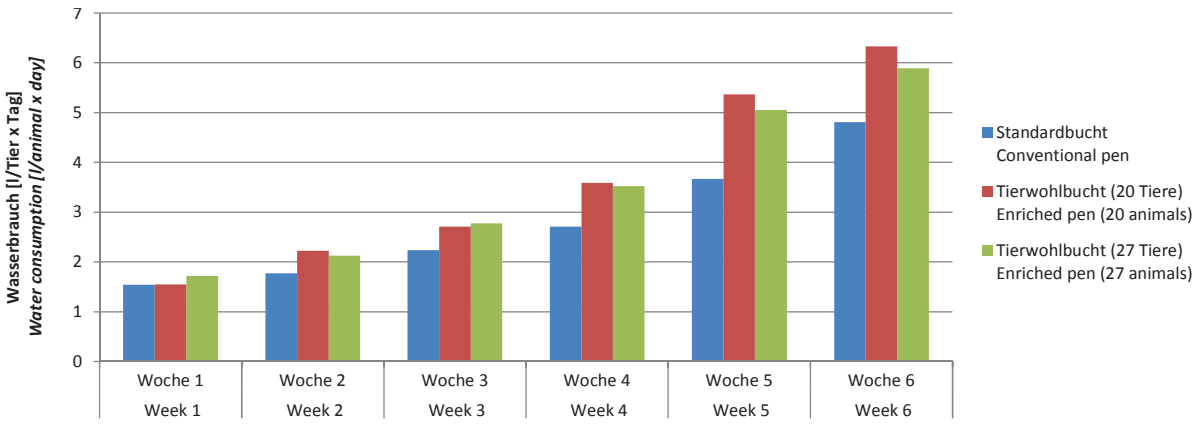
The higher weight gains of the piglets in the enriched pens with 20 animals may have been due to the narrower animal:feeding place ratio, because the feeding places were not adjusted in this study. However, the daily weight gain in the enriched pens with 27 animals were also significantly higher than in the conventional pens with 28 animals. Maybe the provision

Fig. 7



Feed consumption per animal and day over 6 weeks in the different trial versions for both trial runs

Fig. 8



Water consumption per animal and day over 6 weeks in the different trial versions for both trial runs

of roughage and the possibility of natural water intake led to an increased feed intake and affected the weight gain of the animals positively. However, it is also possible that the animals in the conventional pens had a lower feed intake and reached lower daily weight gains because of the higher incidence of tail biting and the associated stress. Another study by the Bavarian State Research Center for Agriculture on the use of various roughage in tail-docked experimental groups, revealed in the groups with feeding Alfalfa also a significantly higher daily weight gain and better feed conversion [15]. Therefore, a displacement of the concentrated feed does not take place. Whether the use of water trough causes an increase in daily weight gains, currently can not be confirmed. This requires further research.

Conclusions

The experiments show, that the occurrence of tail biting could be significantly reduced and delayed by increasing the space allowance and the offer of enrichment materials, including roughage. However, it could not be entirely prevented.

The findings also suggest, that the enrichment of the pens has a higher impact on the reduction of tail biting, than the reduction of stocking density in the pen.

However, the provision of enrichment materials and objects requires some commitment and work input by the animal keeper. Objects must be renewed from time to time, racks and troughs must be regularly refilled in short intervals to provide fresh material. The manure may need to be stirred when a floating layer has formed by the organic material. However, for the purposes of animal welfare, these measures should be taken into account in operational and stable-construction planning in future. Also stable construction and stable equipment companies should develop relevant solutions.

In further experiments should be clarified, whether the increase in the space allowance alone influences the occurrence of tail biting in comparison to the conventional pen. In addition, the effect of different enrichment materials should be investigated in more detail.

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