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Creation of the microclimate of farrowing pens in organic pig production

In an on-farm experiment, temperatures in farrowing pens could have been clearly increased. Initially the lying area and the dunging area of the pens were covered and the leaky flaps to the outdoor area were replaced by high quality airtight doors. In a further experiment, only the lying areas of two of the farrowing pens were covered and PVC-stripes were installed at the opening to the dunging areas. In both versions of the experiment, the temperatures in the covered pens were on average 5,7 K higher than in the non-covered pens and reached temperatures in the lying areas of over 12 °C even at very low outdoor-temperatures (<-10 °C). The increasing of air humidity in the lying area could have been clearly reduced in the second experiment as an effect of the separation from the dunging area by PVC-stripes.

Keywords
Farrowing pen, air temperature, air humidity, microclimate, organic pig production

Abstract
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In organic pig production, there is often the problem of too low temperatures in the farrowing pens, particularly in winter. Internal, unpublished measurements confirm this [1]. Especially at the time of birth, an adequate tempering of the farrowing pen with an air temperature of about 15 °C is an absolute must [2]. In practice, this demand could often not be fulfilled because of the high loss of heat through the openings to the outdoor area, the non-insulated buildings and the low animal units. Because of this, temperatures below 10 °C in the animals´ ambience are not unusual in practice [1]. This problem could be counteracted by limiting the airspace with a covering, reducing the air exchange by tight doors to the outdoor areas and sealing gaps in the housing. The aim of this research was, to determine the effects of these measures on temperature maintenance and air humidity in the pens.

Material and methods

The experiment took place on a Bavarian farm with organic pig production that has two farrowing stables with four and eight farrowing pens. In the smaller stable with four farrowing pens, the examination was carried out.

The building had massive walls, a ceiling height of 210 cm and a wood-great commissure. In the attic above, straw was stored. The farrowing pens were based on the model of "Schweitzer" (**figure 1**). In the original state the openings to the outdoor areas were equipped with swing flaps that showed several leakages (**figure 2**).

In the first experimental period the lying areas and the dunging areas of the two pens in the middle were covered (**figure 3**). The iron bars between the dunging areas were wainscoted with wooden boards and the gaps between the planks of the partitions were tightened with adhesive tapes. The passage from the lying area to the dunging area was open in this experimental setup. In these two pens the flaps to the outdoor areas were replaced by high quality airtight and self-closing doors (**figure 2**). The coverings consisted of each three insulating-boards with a core of 4 cm Styrofoam.

In the second experimental period, each of the four openings to the outdoor areas were equipped with high-quality doors and only the lying areas of the two pens in the middle were covered (**figure 4**). At the passages from the covered lying areas to the non-covered dunging areas, PVC-Stripes had been installed.

Measurements of air temperature and relative air humidity

In each of the four pens two measurement devices ("Testostor 171", company: Testo) were installed 50 cm above the floor, for measuring air temperature and humidity in 1-minute intervals. One of the measurement devices was installed in the lying area

and one in the dunging area of each pen. Additionally, one was placed 10 cm under the ceiling (on 2 m level) between pen 2 and pen 3 above the walkway, for measuring the temperature of the stable and one outdoor for measuring the outside temperature.

Results and discussion

The first measuring period lasted from 5th -29th December 09. The farrowings took place on 7th and 8th December. The measurement device in the lying area of pen 4 failed and because of this, only the results of pens 1 to 3 are shown below.

In this recording period the median of the outside temperature was -0,3 °C and the median of the stable temperature was 11,8 °C. The median of the temperature in the lying area of the non-covered pen (pen 1) was 11,1 °C (**table 1**).

The outside temperature ranged between 0–8 °C in the beginning, and then it dropped and reached -15 °C on 19th and 20th December 09. After that the temperature rose again on about 0 °C **(figure 5**).

Fig. 1

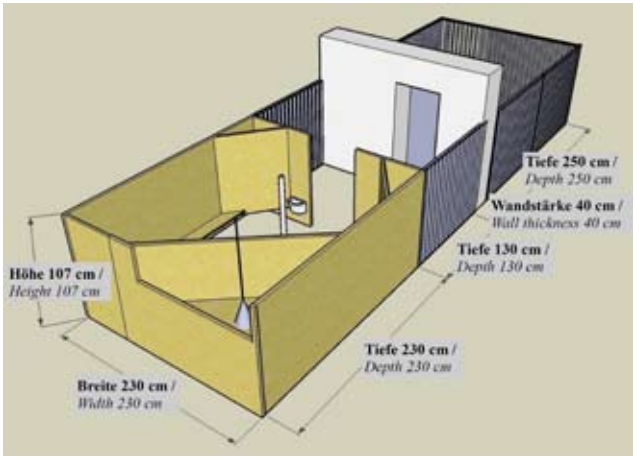


Fig. 1: Sketch of the farrowing pen in the test stable

Fig. 2

Fig. 2: Original flap (left) and high-quality door (right)

Fig. 3

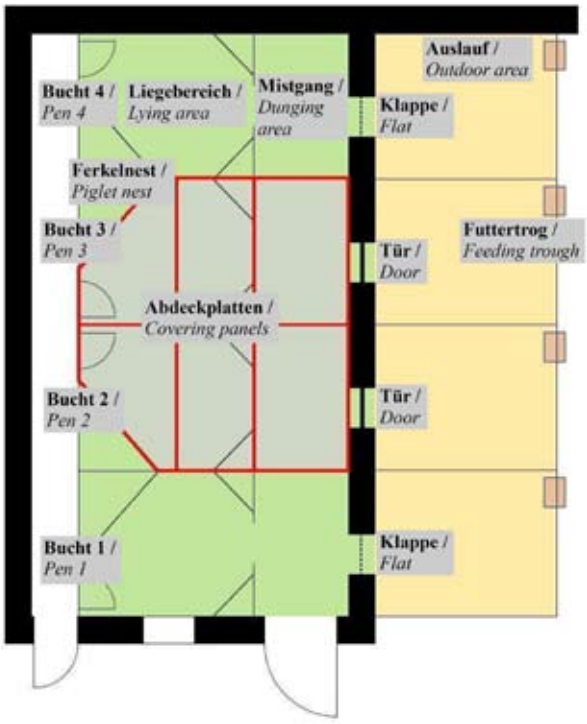


Fig. 3: Covering of the whole farrowing pen in the first experiment

Fig. 4

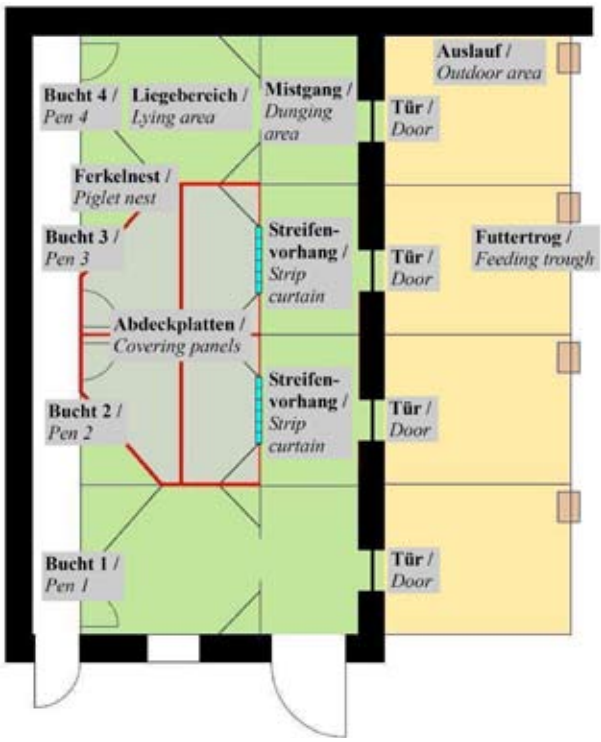


Fig. 4: Covering of the lying-area in the second experiment

In both covered pens the median temperatures of the lying areas reached 16,6 °C in pen 2 and 15,8 °C in pen 3 (**table 1**). The measured values were constantly well above the values of the non-covered pen (up to 10 K).

Altogether, the temperatures in the lying areas of the covered pens in this experimental setup were on average 5,7 K (pen 2) and 5,3 K (pen 3) higher than in pen 1.

In the dunging areas the temperatures were 4,5 K (pen 2) and 4,1 K (pen 3) higher than in the dunging area of pen1.

With the lowest measured outside temperature of -15 °C, the temperature in the non-covered pen was only about 5 °C in lying area and 4 °C in the dunging area.

In contrast, the covered pens reached about 13–15 °C in the lying areas and 10–12 °C in the dunging areas with an outside temperature of -15 °C.

By covering the pens in combination with mounting airtight doors to the outdoor area and sealing gaps in the housing, it was succeeded to comply with the requirement on the minimum temperature of 12 °C in the lying area.

In the first experimental period the relative air humidity in the lying areas of the covered pens was marginally higher than in the non-covered pen. The conversion into the absolute humidity [4] showed a clear increase of the water content in the air (**table 2**).

The second measuring period lasted from 15th February -17th March 10. The farrowings took place on 22th and 23th February.

The median of the outside temperature was 1,5 °C, the average temperature of the stable was 14,5 °C (**table 1**). The temperatures of the four dunging areas were on the same level in this experimental period (median 12,2–12,6 °C) because they were all non-covered.

The temperatures of the covered lying areas were on average 6,0 K (pen 2) and 5,6 K (pen 3) higher than the temperature of the lying area in pen 1 (median 19,9 und 19,5 °C) (**table 1**).

With the lowest measured outside temperature of -12 °C, the temperatures in the lying areas of the non-covered pens were about 11 °C. In contrast, the covered lying areas reached 16–17 °C with this outside temperature. The temperature in the dunging areas was about 9 °C.

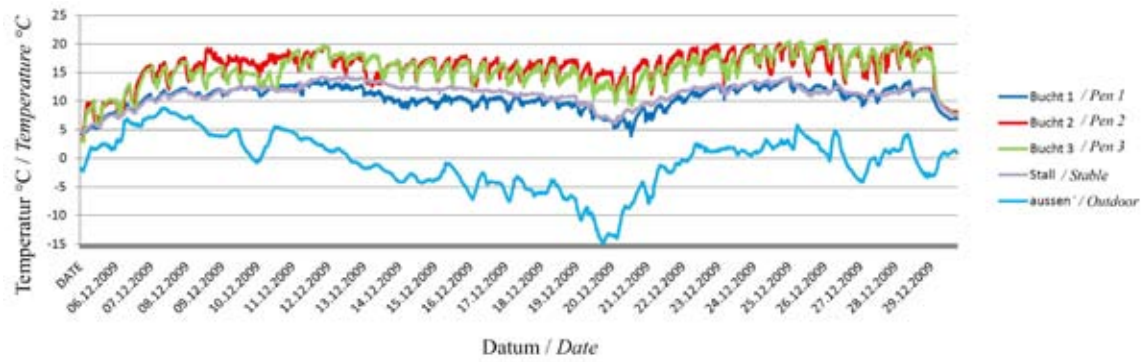
These results confirm the results of the first experimental period and the effect of the covering of the pens in combination with the reduction of the air exchange. Compared to the first experimental setup, the water content of the air was only little

Table 1

Table 1: Median of the measured temperatures in the experimental versions

Temperaturen (Mediane)/ *Temperature (median)*	**Liegebereich Bucht 1/ *Lying-area pen 1***	**Mistgang Bucht 1/ *Dunging-area pen 1***	**Liegebereich Bucht 2/ *Lying-area pen 2***	**Mistgang Bucht 2/ *Dunging-area pen 1***	**Liegebereich Bucht 3/ *Lying-area pen 3***	**Mistgang Bucht 3/ *Dunging-area pen 1***	**Liegebereich Bucht 4/ *Lying-area pen 4***	**Mistgang Bucht 4/ *Dunging-area pen 1***	**Stall/ *Stable***	**Außengelände/ *Outdoor-area***
Versuchsaufbau 1/ *First experiment*	11.1 °C	10.1 °C	16.6 °C	14.3 °C	15.8 °C	13.8 °C	-	-	11.8 °C	-0.3 °C
Versuchsaufbau 2/ *Second experiment*	13.8 °C	12.2 °C	19.9 °C	12.5 °C	19.5 °C	12.6 °C	14.2 °C	12.3 °C	14.5 °C	1.5 °C

Fig. 5



Temperaturverläufe der Liegebereiche, des Stalls und der Außentemperatur in Versuchsaufbau 1

Fig. 5: Temperature profiles of the lying-areas, the stable and the outdoor area in the first experiment

Table 2

Errechnete absolute Luftfeuchtigkeit in den Versuchsvarianten
Table 2: Calculated absolute humidity in the experimental versions

Absolute Luftfeuchte (Mediane)/ ***Absolute humidity (median)***	**Liegebereich Bucht 1/** ***Lying-area pen 1***	**Liegebereich Bucht 2/** ***Lying-area pen 2***	**Liegebereich Bucht/** ***Lying-area pen 3***	**Stall/** ***Stable***	**Außengelände/** ***Outdoor area***
Versuchsaufbau 1/ *First experiment*	8.1 g/m³	12.4 g/m³	11.4 g/m³	8.9 g/m³	4.3 g/m³
Versuchsaufbau 2/ *Second experiment*	9.9 g/m³	11.6 g/m³	11.2 g/m³	10.2 g/m³	4.5 g/m³

higher in the lying area of the covered pens, probably due to the separation from the dunging area by PVC-stripes (**table 2**).

Conclusions

Covering of the pens, replacing the leaky flaps with airtight doors and sealing the gaps in the housing at the same time, led in the practice test to a clear increase of temperatures in the lying areas of the sows: about 5,7 K compared to the non-covered pens.

The pens converted in this way, reached the aspired temperatures in the lying areas (> 12 °C, optimal 15 °C) failsafe, even at very low outside temperatures.

The advantage of the covered pens was mainly shown in very cold phases with less than -10 °C outside temperature. In these cases, 75 % of the measured values in period 1 and 100 % of the measured values in period 2 were over 12 °C in the lying areas of the covered pens. In the non-covered pens in contrast, 0 % of the measured values in phase 1 and only 10 % of the measured values in phase 2 were over 12 °C with outside temperatures of < -10 °C.

Concerning the air humidity, a benefit of separating the lying area from the dunging area was shown. In the first experimental version, the lying areas and the dunging areas of the pens in the middle were covered and the two areas had only a marginal spatial separation from each other. In this case, a clear increase of the absolute humidity compared to the non-covered pen was observed. In the second experimental setup, the absolute humidity in the covered lying areas increased only marginally compared to the non-covered pen, because of the separation from the dunging area.

There is further need for research on the question, how tightness and insulation of the building shell have an effect on the demanded construction of the farrowing pen. Additionally, the behavior and the performance of the animals should be recorded, as well as the optimal ventilation management in covered pens.

Literatur

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