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Water consumption of pigs as indicator for a climate control system

Especially in pig fattening the stable climate affects the health and performance of pigs significantly. The presented project deals particular with the water consumption of piglets. Investigations were done to test a confirmation about the thermal well-being of pigs, by offering tempered water in dependency to the ambient temperature to them. The information can be processed into an animal response signal which is used to guide the new climate control system for piggery. The trials confirmed the presumption that the animals react to different temperatures of the drinking system depending on the ambient temperature in the stable. When the ambient temperature increased, the piglets responded with a higher consumption of cold water. Conclusions can be drawn from their drinking behavior about their thermal well-being. Cooling technologies can be connected.

Keywords
Climate control system, piggery, ambient temperature, water temperature, water consumption, animal welfare, Well-being

Abstract
Landtechnik 68(3), 2013, pp. 178–182, 3 figures, 2 tables, 7 references

Aeration and heating systems fulfil a number of different tasks in pig farming. The stable climate has a significant effect on the performance and health of the animals. The different requirements of pigs as regards temperature poses a particular challenge for farm managers [1]. Draughts in pig stables and temperatures that are too high or that fluctuate affect the animals' welfare and have a negative impact on their performance. This manifests itself in the pigs consuming too much or too little feed, which in turn has a negative impact on their daily weight gain [2]. There are a number of different options for determining the appropriate stable climate for pigs. Firstly, the amount of feed pigs consume indicates their wellbeing [3], as does their lying position [4]. Cannibalism, on the other hand, may be an indicator of an inappropriate stable climate [5]. In order to adjust the room temperature to the animals' needs, it was examined whether weaner piglets change their drinking behaviour, depending on the ambient temperature. To this end, they were provided with three troughs containing water at different temperatures.

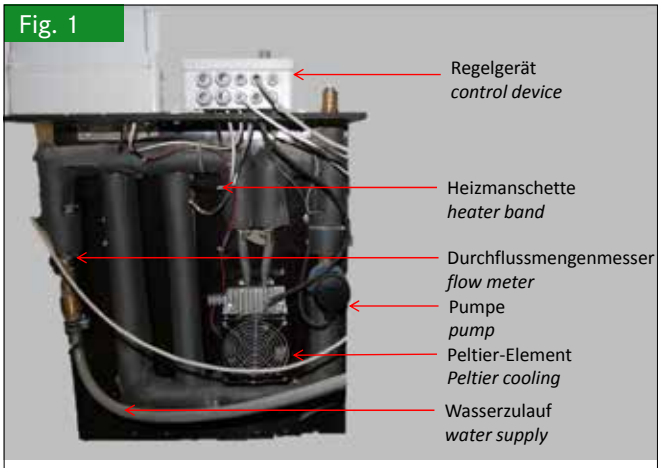
Materials and method

Operating principle of the troughs

Each group received a drinking system that offered a trough with water at room temperature (trough 2), a trough with water that was 10 °C colder than room temperature (trough 1) and one with water that was 10 °C warmer than room temperature (trough 3). The individual troughs had temperature sensors that measured the stable temperature and the water temperature. The target temperature of the water (stable temperature, 10 °C colder, 10 °C warmer) was set in the individual control units. The control unit compared the target temperature and the stable temperature. The system responded to any differences in an appropriate manner, heating or cooling the water as required. Digital flow meters with a flow range of 0.5–30.0 l/min at approx. 480 pulses/l and a measurement accuracy of +/- 2 % were installed, to record water consumption. The information was transferred at 15-minute intervals to the climate control system using a LON bus connection. Temperature sensors recorded the current water and ambient temperatures (**Figure 1**). A special additional function was developed for the climate control system. This function displayed and saved the recorded data for the water consumed by the piglets at the individual troughs, along with the stable and water temperatures.

The trials were carried out at the University of Bonn's training and research centre in Frankenforst. Two groups, each with 21 piglets (breeds used: German Landrace, Pietrain and Duroc), were put into stables. Each group received a drinking system with water at three different temperatures. Ad libitum feed-

Fig. 1



Parts of the drinking system to detect water consumption of weaner piglets in rear view (Foto: Hoeck)

ing from the feeding station, which was located opposite the troughs, was used. The trials were conducted on piglets aged between five and nine weeks. The external and stable temperatures were recorded, along with water consumption and water temperature. CCTV cameras were also installed.

Findings

The drinking system developed complied with requirements. The quantities of water consumed were recorded, along with the ambient temperature. The water temperatures of troughs 1 and 3 were set at about 10 °C colder and 10 °C warmer than ambient temperature. However, the temperature of the water in the troughs deviated from the target temperature. In the trough with cold water, there was an average deviation of 21.6 % (max. 2–3 °C higher than the target temperature). The average deviation was 4.3 % in the trough with water at ambient temperature (max. 1.5 °C under the target temperature) and 1.6 % (between 0.4 and 1.3 °C under the target temperature in the trough with warm water). The higher percentage deviations in the cold trough should be viewed in the context of the ambient temperatures, which were sometimes high. It is considerably more difficult to cool water using a Peltier element in a warm environment than to heat it.

The performance of the individual troughs varied, depending on their function, that is, whether they were cooling or heating water. The output of the cold trough was approx. 249 W, that of the ambient trough approx 12.15 W and of the warm trough approx. 24.5 W. The 21 piglets consumed an average total of 2592.5 l of water in ten uninterrupted trials. Over the five weeks, one piglet consumed an average of 123.4 l of water, drinking approx. 4.4 l of water daily.

The findings show that the piglets' drinking behaviour started to change once the temperature increased or decreased by between 5 and 10 °C. The amount of water they consumed did not change if there was only an insignificant increase or decrease in temperature. **Figure 3** depicts a considerable fluctuation in the ambient temperature. As soon as the stable temperature increases significantly, the piglets consume significantly ($p = 0.009$) more water from the cold trough. This in turn means that they consume significantly ($p = 0.001$) more water from the warm trough at colder ambient temperatures.

In this trial, the temperature varied between 6 and 10 °C. In other trials where the temperature varied greatly, there was also a significant change in drinking behaviour. However, no significant change could be observed in the amount of water consumed if there was only a slight change in the stable temperature (**Table 1**).

If we compare the amount of water consumed at the individual troughs in all trials, a clear preference for a water temperature can be observed. **Table 2** shows all the relevant water

Fig. 2

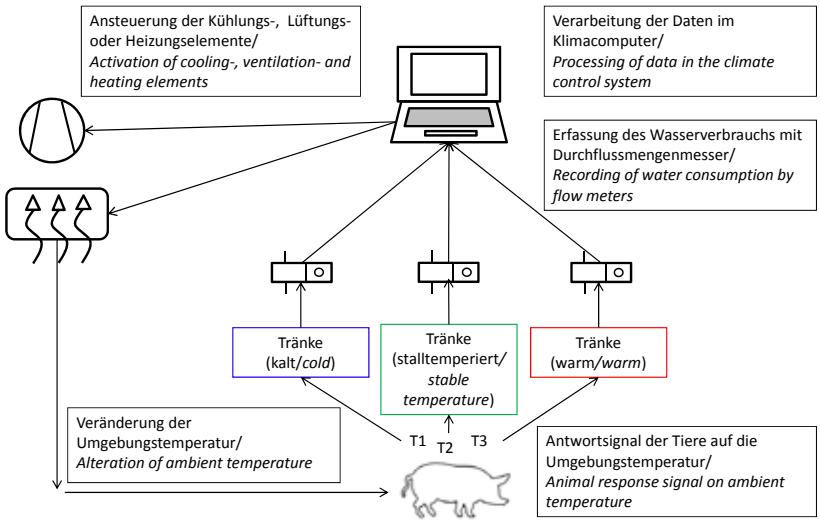
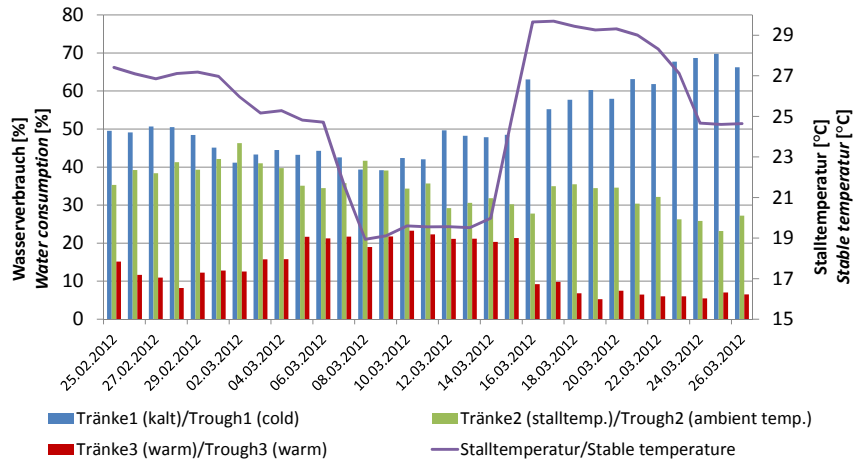


Figure of the animal response on ambient temperature and the reaction of the climate control system

Fig. 3



Relatively water consumption per day in the course of a piglets breeding period at different ambient temperatures

consumption figures trough-by-trough for each trial. The values were divided up into two periods: the fifth and sixth weeks and the seventh to ninth weeks. Temperature ranges were also defined. Within these ranges, the average value of each trough was determined. The only difference in the trials is the different ambient temperatures. On average, the piglets preferred the cold water, irrespective of the ambient temperature. The stable-temperature trough was their second choice, followed by the warm trough, in last place. If we look at the piglets' preferences in the individual trials, we can also see that in 70 % of cases, the piglets preferred drinking from the cold trough, irrespective of the ambient temperature. In three of the ten trials (23 %), the piglets preferred drinking from the stable-temperature trough. The warm trough was only preferred in one trial (7 %). In these trials, the temperature also ranged from 22 to 30 °C.

If we look at the piglets' behaviour at the individual troughs, we can see that they preferred drinking at trough 1, which contained the cold water. At trough 2, which contained water at stable temperature, we can observe a mixture of drinking combined with increased play. The piglets usually played at trough 3. Where the ambient temperatures increased, the piglets mainly drank at trough 1, which contained cold water, and played at the ambient-temperature trough. Trough 3, which contained warm water, was hardly used at all by the piglets in this scenario.

Discussion

The findings show that the piglets respond to extreme fluctuations in the ambient temperature by changing their drinking behaviour. This is particularly evident in cases where the ambient temperature increases. Where the stable temperature is high, the piglets consume significantly more water from the cold trough. These findings are similar to those of Vajrabukka et al. [6], which established that pigs (45–90 kg LM) drink

Table 1

Stable temperature range of different trials and the effect on water consumption of piglets at each drinker

Versuchsnummer *Test number*	Temperaturbereich *Temperature range* [°C]	Gruppennummer *Group number*	Tierzahl *Number of animals*	Signifikanz/*Significance*		
				Tränke/*Trough* 1	Tränke/*Trough* 2	Tränke/*Trough* 3
7	18.9–29.6	1	20	0.009	0.012[1)]	0.001[1)]
		2		k. A.[2)]	k. A.	k. A.
13	23.4–33.8	1	21	0.018[1)]	0.015[1)]	0.001[1)]
		2	21	0.017[1)]	0.012[1)]	0.013[1)]
9	25.7–29.3	1	21	0.104	0.668	0.001[1)]
		2	21	0.105	0.461	0.384
10	25.1–30.1	1	19	0.596	0.034[1)]	0.442
		2	20	0.383	0.575	0.564

[1)] Univariate Varianzanalyse (Anova)/*variance analysis (Anova)*, p = 0,05.
[2)] k. A. = Datenausfall/*data deficiency*.

Table 2

Relative water consumption of piglets of all trials, classified in periods and temperature ranges

Zeitabschnitt *Period*	**Temperaturbereich** *Temperature range* [°C]	**Mittelwert/*Arithmetic average***		
		Tränke/*Trough* 1 [%]	**Tränke/*Trough* 2** [%]	**Tränke/*Trough* 3** [%]
5. und 6. Lebenswoche/*Week*	21-25	43.6	32.2	24.1
	26-30	46.9	31.3	21.7
	31-34	43.8	39.3	16.7
7. bis 9. Lebenswoche/*Week*	21-25	45.9	26.8	27.4
	26-30	57.8	28.2	14.0
	31-34	58.4	26.0	15.7

more cold water (11 °C) if the ambient temperature is 35 °C. Steinhardt et al. [7] also found that pigs prefer drinking cold water at high ambient temperatures. It is more difficult to assess pigs' wellbeing if the temperature changes by less than 5 °C . Piglets respond to high ambient temperatures. However, their drinking behaviour does not vary greatly if the temperature only changes slightly. The animals' clear preference for cold water and individual drinking behaviour at different ambient temperatures are additional factors.

Conclusions

In order to respond to pigs' water consumption behaviour, the data recorded are used to identify the ratio of water consumed at each trough, and a dynamic average value for the past 24 hours is determined on this basis. From this ratio, the normal distribution (for example for piglets 60 % cold, 30 % ambient temperature, 10 % warm) is determined. This result can then be used to make a recommendation on modifying the temperature, and depicted on the display panel. By using the ratio between the individual troughs, the situation can be assessed independently of the total quantity of water consumed, and therefore independently of the number of animals as well. In the individual trials, the drinking behaviour of the piglet groups differed, which means that it is not always possible to clearly process a response signal. For this reason, it should be possible to process a response signal based on the specific situation, and for the livestock farmer to make a decision accordingly.

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Note

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