Animal Health in Outside Climate Housing with Kennels for Fattening Pigs

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For the assessment of the health status of fattening pigs in two outside climate stalls with resting kennels and a conventional warm house, their nasal flora was tested for four pathogens. Pasteurella haemolytica and Actinobacillus pleuropneumoniae could not be found. It was possible to isolate Pasteurella multocida and Bordetella bronchiseptica from animals in every stall compartment. The percentage of germ carriers developed non-uniformly in the systems and mostly without significant differences. A clear connection between detectable pathogens and lung diagnoses in the slaughterhouse could not be established. Damage to the integument (bursae auxiliares at the limbs) did not show any clear differences between the housing systems. With regard to the locomotor system, all three systems are characterized by few lame animals and prove flawless housing.

Keywords
Pig, outside climate house, kennel housing, animal health, pasteurella, bordetella, bursa auxiliaris, lameness

Introduction

While animals kept outdoors are exposed to the direct influences of the weather and the climate, a combination of factors develops in a stall which, especially in an outside climate house, exhibits a close relation to the climate of the environment and is also determined by the room characteristics, the number of animals, animal behaviour, housing techniques, and management [1].

Most conventional warm houses feature temperature-dependent indoor climate control through forced ventilation. Slatted floor compartments with a uniform structure are predominant. The outside climate stall with kennels, however, is characterized by free ventilation, which is mainly influenced by the wind, as well as zoned pens and temperature-insulated resting kennels. The effects of the stall climate in conventional houses on the health of the respiratory tract have been described in several publications [2] [3] [4] [5]. Lung results on the slaughtering line allowed conclusions to be drawn regarding the stall climate of individual housing systems [6] [7] [8].

The present study was supposed to answer the question of whether the altered climatic conditions in the outside climate house with kennels (climate stimulus, temperature zones, resting kennels, ...) exert an influence on the health of the respiratory tract in particular.

Material and Method

On a farm, three separate units with 64 animals and four pens each (conventional warm house with slatted floor (kW), outside climate house with resting kennels and partially slatted floor (AKt), outside climate house with resting kennels and littered dung area (AKe)) were compared directly [9]. Differences between the systems only affected the buildings (outside climate houses, warm stall), ventilation (free, forced), the climate zones (two or one), and the heterogeneity which is common in practice when 600 rearing piglets are purchased at the same time. The climate, food/feeding, and the administration of medicine were checked, and the system-immanent disease pressure was determined using the existence of pathogens causing repiratory diseases in the nasal cavity, as well as alterations of the integument and the locomotor system as criteria.

During three fattening periods (in-and-out with selective sale), a smear from the first eight centimetres of the nasal cavity of each animal was taken with sterile disposable swabs at the beginning (3rd fattening day, ca. 29 kg of living mass), in the middle (45th fattening day, ca. 48 kg LM), and at the end (90th fattening day, ca. 83 kg LM).

The subsequent microbiological examination with the aid of selective and non-selective nutritive media allowed for the qualitative establishment of specific pathogens in the nasal cavity. Tests were carried out to determine the occurence of the pathogens *Pasteurella multocida, Pasteurella haemolytica, Bordetella bronchiseptica,* and *Actinobacillus pleuropneumoniae. Pasteurella multocida* often colonizes the mucosae of the respiratory tract and the nasopharyngeal tonsils of healthy pigs. In synergy with other germs, it can cause pathogenic effects. *B. bronchiseptica* frequently occurs as a secondary pathogen during virus- and mixed infections. This pathogen especially causes diseases in places where many animals are kept in a very confined space. Together with *P. multocida*, it causes the syndrome „porcine atrophic rhinitis“ in pigs. This disease reduces weight gain, delays the readiness for marketing (readiness for slaughtering) of the animals, and thus leads to significant financial losses [10].

The reasons for external, visible damage are stall equipment (technopathy), conspecifics, or deviant behaviour (ethopathy). It is ultimately caused by housing. The kind and the seriousness of the damage may serve as a criterion for the evaluation of housing systems [11]. The type, the roughness, and the hardness of the resting- and loose areas are mentioned as the main reasons for damage to the limbs (insufficient claw abrasion, callus formation). In addition, a clear pen structure, the presence of litter, and the adaptation of the housing system to the weight over the entire duration of the fattening period, as well as exposure and the spatial demands of the animals exert a positive influence on their general condition. Injuries of the ears, the tail, the head, and the trunk are dependent on the occurring aggressions. Aggressive and exploratory behaviour generally has complex reasons (pen structure, litter, lack of stimuli, stall temperature and -climate).

Each animal was visually inspected by a veterinarian for dyspnoea, diarrhoea, lameness, pathologically altered claws, arthritis, pathological alterations of the skin, and externally visible traumata.

With the aid of electronic earmarks, it was possible to identify each animal at any time. This enabled the persistence of the pathogens and diseases, as well as their healing to be documented and correlated with the diagnoses from the slaughterhouse.

The four identical pens per stall were regarded as measurement repetitions and thus allowed a bifactorial variance analysis to be conducted for triple classification according to the factors stall, fattening phase, and their interactions.

Results

The variance-analytical assessment of the results with regard to the infestation with *P. multocida* and *B. bronchiseptica* did not show any substantial systematic differences between the housing systems, the fattening phases, and the interactions of these two factors (**tables 1** and **2**).

In the case of *P. multocida* (table 1), only the fattening phases in the 3rd period exhibited highly significant differences. The same applies to the interactions between the housing system and the fattening phase. In periods 4 (not sampled at the beginning) and 5, the average percentage of detectable pathogens was considerably lower than in the previous period.

The percentage of *B. bronchiseptica* in the nasal flora (table 2) also shows great heterogeneity, which cannot be explained as a result of the examined factors. The pathogen could not be detected at the beginning of period 3 (late analysis with strong secondary flora). As a tendency, a slightly higher degree of infestation was observed in the outside climate houses. Statistically, however, this was only proved for period 3. Differences between the fattening phases only occurred in period 4.

If the relative percentage of infested animals is compared for both groups of pathogens, it becomes clear that the levels exhibit significant differences between the periods and within the systems. This indicates that in addition to the housing system other factors (status at the time of stalling up, genetics, etc.) exert a very strong influence on infestation. The concentration of the pigs and their pathogens in the kennel, as well as their close contact there did not result in an increase in either the biological disease pressure or the frequency of clinical illnesses.

With regard to the occurrence of bursae auxiliares at the fore- and hind limbs, which are caused by the hard ground (**table 3**), no differences could be found in periods 3 and 4. During period 5, the housing systems, the fattening phases, and their interaction showed a highly significant difference. This must be attributed to the high temperatures and animal behaviour, as well as other factors. With growing weight, lying in the outside climate house shifted from the level concrete kennel area to the perforated (AKt) or the littered level concrete (AKe) dung area. In the conventional warm stall, a large percentage of bursae auxiliares was already diagnosed briefly after stalling up.

Damage to the locomotor system was recorded if the animal showed visible signs of lameness (**table 4**). The results were inconclusive. During period 3, no clear differences were found. During period 4, however, there were significant differences between the fattening phases and, in

Table 1: Percentage of fattening pigs with P. multocida in the nasal flora depending on housing and fattening phase

Periode system/phase	3				4				5			
	A	M	E	G	A	M	E	G	A	M	E	G
Outside climate partly slatted floor												
Animals	64	62	52	178		63	60	123	64	62	57	183
Cause %	11	34	21	22		8	20	14	1	12	24	12
Variance %	1	2	5	3		1	2	2	0	0	1	1
Outside climate bedded dunging												
Animals	64	64	49	177		63	60	123	64	63	58	185
Cause %	6	57	7	23		12	12	12	12	18	14	14
Variance %	1	1	1	7		0	0	0	2	3	1	2
conventional insulated housing												
Animals	26	25	21	72		34	36	70	36	35	35	106
Cause %	12	24	33	23		25	23	24	4	2	13	6
Variance %	1	1	1	1		3	0	2	1	0	4	2
Total												
Animals	154	149	122	425		160	156	316	164	160	150	474
Cause %	10	39	20	23		15	18	17	6	11	17	11
Variance %	1	3	3			2	1		1	2	2	
System				n. s.				n. s.				n. s.
Phase				***				n. s.				n. s.
Interaktion				***				n. s.				n. s.

Analysis of variance, bifactorial, four repetitions (four pens per system)
Phase A: beginning, M: middle, E: finish, G: total
level of significance: n. s. - (none) * - ($p < 0,05$) ** - ($p < 0,01$) *** - ($p<0,001$)

Table 2: Percentage of fattening pigs with B. bronchiseptica in the nasal flora depending on housing system and fattening phase

Periode system/phase	3				4				5			
	A	M	E	G	A	M	E	G	A	M	E	G
Outside climate partly slatted floor												
Animals		62	52	114		63	60	123	64	62	57	183
Cause %		47	51	49		73	63	68	30	30	59	40
Variance %		3	1	2		1	1	1	3	1	4	4
Outside climate bedded dunging												
Animals		64	49	113		63	60	123	64	63	58	185
Cause %		52	52	52		66	44	55	19	51	45	38
Variance %		0	15	6		1	3	3	1	4	2	4
conventional insulated housing												
Animals		25	21	46		34	36	70	36	35	35	106
Cause %		28	14	21		86	44	65	17	33	31	27
Variance %		1	1	1		3	1	7	6	16	16	11
Total												
Animals		149	122	271		160	156	316	164	160	150	474
Cause %		42	39	41		75	50	63	22	38	45	35
Variance %		2	8			2	2		3	6	7	
System				**				n. s.				n. s.
Phase				n. s.				***				n. s.
Interaktion				n. s.				n. s.				n. s.

Analysis of variance, bifactorial, four repetitions (four pens per system)
Phase A: beginning, M: middle, E: finish, G: total
level of significance: n. s. - (none) * - ($p < 0,05$) ** - ($p < 0,01$) *** - ($p<0,001$)

Table 3: Percentage of fattening pigs with bursae auxiliares (visually detectable) depending on housing system and fattening phase

Periode system/phase	3				4				5			
	A	M	E	G	A	M	E	G	A	M	E	G
Outside climate partly slatted floor												
Animals	64		52	116		63	60	123	64		57	121
Cause %	3		0	2		3	0	2	0		23	12
Variance %	0		0	0		0	0	0	0		1	2
Outside climate bedded dunging												
Animals	64		49	113		63	60	123	64		58	122
Cause %	2		2	2		5	0	2	0		11	5
Variance %	0		0	0		1	0	0	0		1	1
conventional insulated housing												
Animals	26		21	47		34	36	70	36		35	71
Cause %	0		0	0		6	0	3	25		21	23
Variance %	0		0	0		1	0	0	1		0	1
Total												
Animals	154		122	276		160	156	316	164		150	314
Cause %	2		1	1		5	0	2	8		18	13
Variance %	0		0			0	0		2		1	
System				n. s.				n. s.				***
Phase				n. s.				**				***
Interaktion				n. s.				n. s.				***

Analysis of variance, bifactorial, four repetitions (four pens per system)
Phase A: beginning, M: middle, E: finish, G: total
level of significance: n. s. - (none) * - (p < 0,05) ** - (p < 0,01) *** - (p<0,001)

Table 4: Percentage of fattening pigs visually detectable lameness depending on housing system and fattening phase

Periode system/phase	3				4				5			
	A	M	E	G	A	M	E	G	A	M	E	G
Outside climate partly slatted floor												
Animals	64		52	116		63	660	123	64		57	121
Cause %	0		4	2		0	0	0	1		7	4
Variance %	0		0	0		0	0	0	0		0	0
Outside climate bedded dunging												
Animals	64		49	113		63	60	123	64		58	122
Cause %	3		6	5		8	0	4	0		0	0
Variance %	0		1	0		0	0	0	0		0	0
conventional insulated housing												
Animals	26		21	47		34	36	70	36		35	71
Cause %	0		5	3		0	0	0	0		2	1
Variance %	0		0	0		0	0	0	0		0	0
Total												
Animals	154		122	276		160	156	316	164		150	314
Cause %	1		5	3		3	0	2	0		3	1
Variance %	0		0			0	0		0		0	
System				**				n. s.				n. s.
Phase				***				***				n. s.
Interaktion				n. s.				***				n. s.

Analysis of variance, bifactorial, four repetitions (four pens per system)
Phase A: beginning, M: middle, E: finish, G: total
level of significance: n. s. - (none) * - (p < 0,05) ** - (p < 0,01) *** - (p<0,001)

period 5, also between the housing systems. In the third period, the percentage of lame animals increased to three to five percent in all systems towards the end of the fattening period. However, the differences between the systems can be explained by the individual initial level. Only in the AKe did eight percent of the animals show locomotory restrictions in the middle of the fourth fattening period. At the end of the fattening period, no lameness was observed in any system. This not only provides the reason for the considerable difference between the fattening phases, but also for the interaction between the housing system and the fattening phases. During the fifth period, lameness occurred in the AKt and kW, reaching up to 7 percent. However, there was no significant connection.

The decisive question is how many pigs developed lung diseases. **Table 5** lists the percentage of those animals in a stall system which showed lung alterations in the slaughterhouse. Among the lungs recorded were not only those which had to be discarded because of acute infections, but also lungs whose earlier, healed inflammations manifested themselves only through wound calluses. An average of 2% in the first period and 13% in the third period had to be discarded for this reason. The health status of the animals in the third period was by far the worst. This is also a partial explanation for the high values of 17 and 30% of lung results in the test compartments.

Table 5: Percentage of fattening pigs with pulmonary result, nose result and set of cut depending on housing system and fattening period

Nr.	Cause (%)	G	AkT	AkE	kW
1	Lung result	2	2	2	6
2	Lung result	4	16	2	8
3	Lung result	13	17	30	11
	Nose result		81	95	69
	Set cut		17	30	3
4	Lung result	5	10	2	9
	Nose result		90	84	97
	Set cut		10	0	7
5	Lung result	9	24	4	0
	Nose result		83	88	86
	Set cut		18	2	0

G = total
AKt = Outside climate housing partly slatted floor
AKe = Outside climate bedded dunging
kW = conventional housing slatted floor

Those animals in which one of the four bacterial pathogens was detected at least once during the entire fattening period reach values of 69 to 97 percent. A causal, mutual connection between the lung results in the slaughterhouse and detectable nasal pathogens cannot be proved. This is also confirmed by the cut set of the animals with lung results and the germ carriers during fattening because nasal results did not provide an explanation for all discarded lungs.

The evaluation of the individual applications of medicine for infections (of the respiratory tract and others) was inconclusive with regard to differences between the fattening periods and within the periods. This must partly be attributed to the different health status at the time when the animals were stalled up and to variations in stalling-up prophylaxis. Nevertheless, it was shown that rearing piglets with prophylaxis required fewer treatments of individual animals than piglets from three sources. All in all, the immediate administration of medication at the time of stalling up provides more favourable results than the application of medicine when the first symptoms appear.

Discussion and Conclusion

Infestation diagnoses with a comparable number of samples were not available in the literature. Therefore, it is impossible to classify the results. The fact that virtually no significant differences could be detected between all three systems shows that the hypothesis „good ventilation leads to lower infestation pressure“ did not prove true and that other factors (higher concentration of pathogens in the kennel air, immune status of the piglets at the time of stalling up, etc.) are also decisive for infestation with pathogens.

In all three stall systems, damage due to housing occurred only to a small extent, which is proof of the efforts to design each system optimally within its bounds.

The classification of the slaughterhouse diagnoses and the cut set with the nasal results proves that the mere existence of pathogens in the upper respiratory tract does not indicate clinical diseases. It may be recorded, however, that despite the latent disease pressure only a few animals became sick in all three systems, which is caused by the other positive housing factors.

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