THE EFFECT OF REARING SYSTEM AND FEEDING WITH OR WITHOUT ALFALFA FORAGE ADDITION ON THE BEHAVIOUR OF GROWING-FINISHING PIGS

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Abstract. The experiment was performed on a total of 90 crossbred pigs [♀(♀PL x ♂ PLW) x ♂ (♀ P x ♂ D)] divided into experimental groups based on the analogue method, i.e. on the origin of litter, sex and initial body weight. The pigs were assigned to six experimental groups (15 animals per group – 7 barrows and 8 gilts): group 1 – animals fed a complete diet and kept indoors with access to outdoor runs, group 2 – animals fed a complete diet and kept indoors in pens with straw bedding, group 3 - animals fed a complete diet and kept indoors in pens without straw bedding, group 4 - animals fed a complete diet and alfalfa forage, kept indoor with access to outdoor runs, group 5 - animals fed a complete diet and alfalfa forage, kept indoors in pens with straw bedding, group 6 - animals fed a complete diet and alfalfa forage, kept indoors in pens without straw bedding. The following six behaviour patterns were recorded twice at each stage of fattening, i.e. at approximately 50 kg and 100 kg BW: - resting, - moving activity, - feeding – voluntary ingestion of a complete diet, - feeding – voluntary ingestion of alfalfa forage, staying outside in the run, other activities.

All management systems were animal welfare-friendly. Both at the first and second stages of fattening (approx. 50 kg and 100 kg BW, respectively), the experimental factors had a significant effect on the majority of behaviour patterns in pigs - moving activity (α=0.05 in a first stage of fattening and α=0.01 in the second stage of fattening), rest (α = 0.01 in both stages of experiment), and the time spending on outdoor runs. The results of this study confirmed the thesis that rearing with free access to outdoor runs, feeding with addition of bulk feed, i.e. alfalfa forage, or rearing in pens with straw bedding are methods of improving of fatteners welfare.

Keywords: growing-finishing pigs, indoor system, outdoor system with access to runs, straw bedding, alfalfa forage, behaviour.

Introduction

Animal management and housing systems undergo constant modifications since animal welfare has become an increasingly significant issue, widely discussed in scientific literature (Edwards 1994, Kołacz, Bodak 1999, Temple et al. 2011). The use of objective welfare assessment methods for the determination of animal well-being and comfort as affected by living conditions is an important consideration (Kołacz, Bodak 1999). According to some authors (e.g. Kozera et al. 2009), the straw and strawless husbandry systems represent two opposite ends of the animal welfare assessment scale.

Pig behaviour, considered to be a long-term indicator of welfare, is determined by a number of factors, including the size and shape of pens, the age, number and sex of animals kept together, nutritional regime, access to feed and bedding, and external (environmental) stimuli. The range of activities and behaviours displayed by animals is an important measure of welfare (Klocek et al. 2005, Kozera 2007). In practice, live observations of animal behaviour are usually carried out for one day or a part of the day (Jensen et al. 2010, Kozera 2007, Kozera et al. 2009), and they are limited to one or several animals (Klocek et al. 2005). Modern technological solutions allow observing and documenting behaviour patterns in larger groups of animals, which makes the collected behavioural data more reliable (Klocek et al. 2000).

There has been an increasing interest in alternative pig feeding and housing systems in recent years. New livestock farming practices are introduced to improve animal welfare and increase their disease resistance (Kołacz, Bodak 1999, Temple et al. 2011), as well as to support the production of organic, health-promoting foods with high nutritional value, in response to growing consumer demand (Kozera 2007, Sundrum 2001). Particular attention should be paid to outdoor animal production systems, aimed to maintain animal health and well-being, and to provide high-quality food products (Edwards 1994, Rodriguez-Estevez et al. 2010, Sundrum 2000).

Environmental factors are known to affect both the behaviour and production traits of animals, and their impact is much more noticeable in indoor with access to outdoor runs systems. The productivity of pigs kept in confinement and with outdoor access has been compared in numerous studies, yet the results obtained to date are inconclusive and often contradictory. In a study by Gentry et al. (2002), pigs reared outdoors were characterized by a faster growth rate than pigs kept indoors. A similar trend was noted by Millet et al. (2004, 2005) and Stern et al. (2003). Gentry et al. (2004) reported a higher growth rate and better feed conversion in pigs reared with outdoor access. On the other hand, Bee et al. (2004), Hoffman et al. (2003) and Enfält et al. (1997) demonstrated that growing-finishing pigs raised indoors were characterized by higher daily gains. According to Sather et al. (1997), pigs having access to outdoor run areas reached 105 kg BW approximately 16 days later than pigs kept in confinement. Stern et al. (2003) observed worse feed conversion in indoor with access to outdoor runs pigs.

In organic production systems, pigs are fed farm-made roughage and are kept in natural indoor with access to

outdoor runs conditions, with access to pasture (Kozera 2007, Mowat et al. 2006, Rodriguez-Estevez et al. 2010).

There is a scarcity of published studies investigating the influence of feeding supplemental alfalfa on the behaviour of growing pigs raised under different husbandry systems. In view of the above, the objective of this study was to determine the effect of housing system (indoor and indoor with access to outdoor runs; with or without straw bedding) and dietary regime on the behaviour patterns of growing-finishing pigs.

Material and methods

The study was conducted in the spring of 2012 on a pig production farm at the Production-Experimental Station in Bałcyny near Ostróda (NE Poland). The experiment was performed on a total of 90 crossbred pigs [♀ (♀ Polish Landrace x ♂ Polish Large White) x ♂ (♀ Pietrain x ♂ Duroc)] divided into experimental groups based on the analogue method, i.e. on the origin of litter, sex and initial body weight.

Complete pig diets, with a total protein content of 15.6%, were formulated using farm-grown cereal grains. The only high-protein component was soybean meal. The final composition of experimental diets was determined after chemical analyses of raw materials. During the experiment, the selected groups received alfalfa as green forage (cv. LEGEND, second year of growth).

The pigs were assigned to six experimental groups (15 animals per each group – 7 barrows and 8 gilts): 1. animals fed a complete diet and kept indoor with access to outdoor runs, 2. animals fed a complete diet and kept indoors in pens with straw bedding, 3. animals fed a complete diet and kept indoors in pens without straw bedding, 4. animals fed a complete diet and alfalfa forage, kept indoor with access to outdoor runs, 5. animals fed a complete diet and alfalfa forage, kept indoors in pens with straw bedding, 6. animals fed a complete diet and alfalfa forage, kept indoors in pens without straw bedding.

In the indoor systems, pigs were kept in pens with a floor area of ca. 25 m^2. Wheat straw was replaced three times a week. In the indoor with access to outdoor runs system, pigs were kept in open brick buildings (6 m x 4 m) with free access to outdoor runs devoid of vegetation (ca. 1000 m^2 each). No parameters of microclimate were measured.

Complete diets in friable form were available in automatic feeders, while alfalfa forage was served in separate stoneware troughs. Both feeds were fed *ad libitum*. The pigs had free access to water from automatic drinkers.

Observations of the behaviour of experimental pigs were carried out twice at each stage of fattening, i.e. at approximately 50 kg and 100 kg BW, during three two-hour sessions every day, at 9^{00}-11^{00}, 12^{00}-14^{00} and 15^{00}-17^{00}, as described by Stern and Andresen (2003). Different types of animal behaviour were monitored only in the building and recorded using industrial cameras and video recorders, on the same day, for each group separately. To facilitate identification, consecutive numbers were painted on the backs and sides of individual animals, using aerosol spray markers.

The following six behaviour patterns were recorded: - resting, - moving activity, - feeding – voluntary ingestion of a complete diet, - feeding – voluntary ingestion of alfalfa forage, staying outside in the run, other activities.

The group of "other activities" included behaviours that were rarely encountered during 360 minutes of observation, such as exploration, drinking, leaping, etc. At the completion of observations, etograms were made describing the duration (at 5-min intervals) and occurrence frequency of all activities. The number of series of each behaviour, its duration and share of the total observation time (360 min.) were calculated according to the method proposed by Winnicki and Wagner (1988).

The obtained results were processed statistically by standard methods applied in studies of the type. Calculations were performed using STATISTICA PL 7.0 software.

Results and Discussion

Pig behaviour is considered to be a long-term indicator of welfare, which is why one of the aims of this study was to evaluate pig behaviour in view of the housing system and supplemental feeding of roughage. The analysis was based on both subjective observations and an evaluation of the following six types of behaviour: resting, moving activity, feeding – voluntary ingestion of a complete diet and green forage, staying outside in the run, other activities.

The duration of different behaviours at the first stage of experiment (ca. 50 kg BW) is presented in Fig. 1 and Table 1. The predominant behaviour of pigs housed indoors was resting. The percentage of time spent resting, relative to the total observation time (360 min.), ranged from 58.06% (209 min.) in group 6 with animals kept indoors without straw bedding and fed alfalfa forage to 74.07% (266.7 min.) in group 3 with animals raised indoors without straw and fed a complete diet. The indoor with access to outdoor runs pigs rested for 57.7 min. (16.02%) (the group fed supplemental alfalfa) and 64.3 min. (17.87%) (the group fed a complete diet). The number of series of identical behaviour reflects the occurrence frequency of a given form of activity. The highest values of this parameter were determined in groups 2 and 6, at 6.0 and 5.5, respectively. There were significant differences between groups in the mean values for resting behaviour.

The data in Fig. 2 and Table 2 show that at the second stage of the study (ca. 100 kg BW), similarly as at the first stage, pigs of group 4, kept outdoors and fed with addition of alfalfa, spent least time resting (14.35%, 51.6 min.), while animals of group 3, housed indoors without straw bedding and fed a complete diet, spent the greatest percentage of time resting (78.61%, 283 min.). Just like at the first stage of fattening, the differences between treatments were statistically significant.

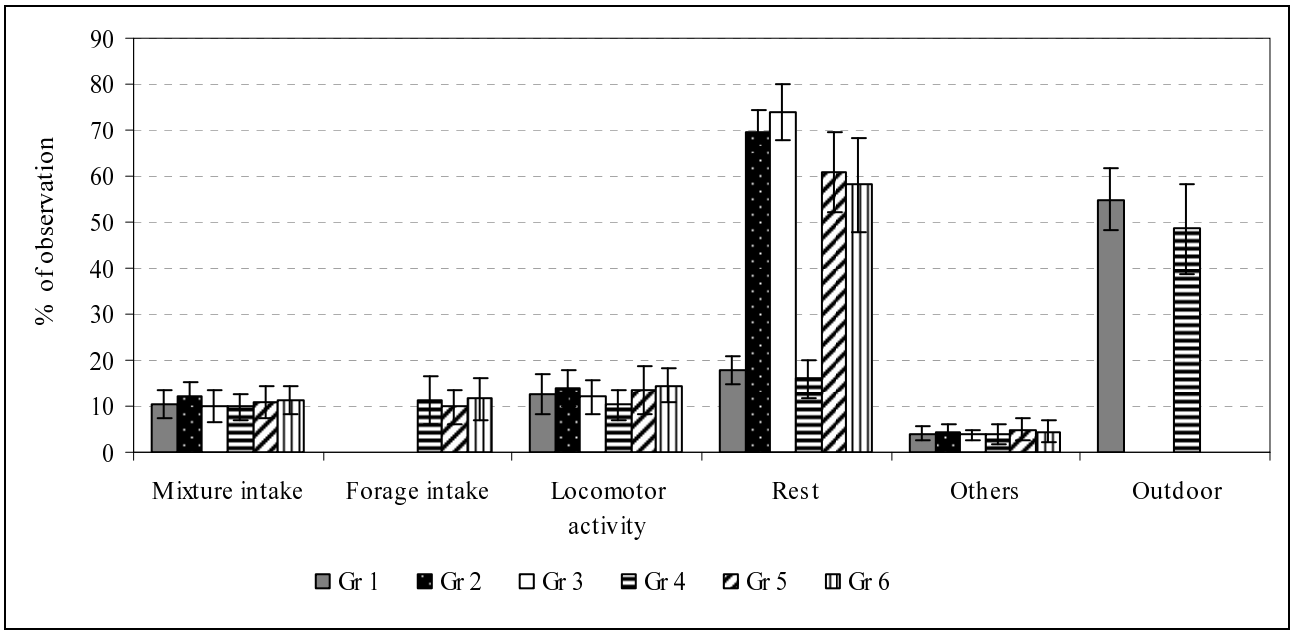

Fig. 1. **Behavior of fatteners at the initial stage of observation** (50 kg b. w.)

Table 1. **Behaviour of fatteners in the first phase of fattening** (50 kg b. w.)

Specification	Stat.	Feeding on mixture			Feeding on mixture and alfalfa forage			SEM	Significance level	
		With access to outdoor runs (1)	Indoor +straw bedding (2)	Indoor without straw bedding (3)	With access to outdoor runs (4)	Indoor +straw bedding (5)	Indoor without straw bedding (6)		Rearing	Feeding
Mixture intake										
- number	x	3,7	3,9	4,4	3,9	4,1	3,5	0,17	NS	NS
of series	s	1,11	1,46	1,12	1,49	0,96	0,92			
- total time	x	37,7	44,3	36,3	35,3	39,3	40,7	1,18	NS	NS
	s	10,50	9,79	12,17	10,77	12,23	10,66			
Forage intake										
- number of series	x	-	-	-	2,9	3,1	2,7	0,17	NS	-
	s	-	-	-	0,92	1,33	1,09			
- total time	x	-	-	-	40,7	35,7	41,6	2,41	NS	-
	s	-	-	-	19,44	13,21	16,54			
Moving activity in the building										
- number	x	4,3	5,1	4,5	3,9	4,7	5,3	0,17	**	NS
of series	s	1,63	1,59	1,35	1,41	1,75	1,23			
- total time	x	45,7	$49,7^{a}$	43,67	$37,0^{b}$	48,3	$52,3^{a}$	1,58	**	NS
	s	15,68	13,95	13,15	11,46	18,38	13,47			
Time spending on outdoor runs										
- number	x	4,9	-	-	5,3	-	-	0,26	-	NS
of series	s	1,03	-	-	0,90	-	-			
- total time	x	$197,7^{A}$	-	-	$175,0^{B}$	-	-	9,51	-	NS
	s	23,8	-	-	9,14	-	-			
Rest in the building										
- number	x	4,1	6,0	5,2	5,1	5,4	5,5	0,12	**	NS
of series	s	1,12	1,19	1,08	0,99	0,98	0,64			
- total time	x	$64,3^{BD}$	$251,0^{A}$	$266,7^{A}$	$57,7^{BD}$	$219,0^{BC}$	$209,0^{BC}$	9,33	**	NS
	s	11,31	17,03	22,01	15,1	31,63	36,45			

Table 1. **Continue**

Specification	Stat.	Feeding on mixture			Feeding on mixture and alfalfa forage			SEM	Significance level	
		With access to outdoor runs (1)	Indoor +straw bedding (2)	Indoor without straw bedding (3)	With access to outdoor runs (4)	Indoor +straw bedding (5)	Indoor without straw bedding (6)		Rearing	Feeding
Other activities										
- number	x	2,6	2,3	2,9	2,1	2,5	2,5	0,11	NS	NS
of series	s	1,05	0,98	0,91	1,06	1,25	1,19			
- total time	x	14,7	15,0	13,3	14,3	17,7	16,3	0,72	NS	NS
	s	5,16	6,81	3,62	7,53	8,42	8,55			
*, a, b – α = 0,05; **, A, B – α = 0,01; NS –not significant										

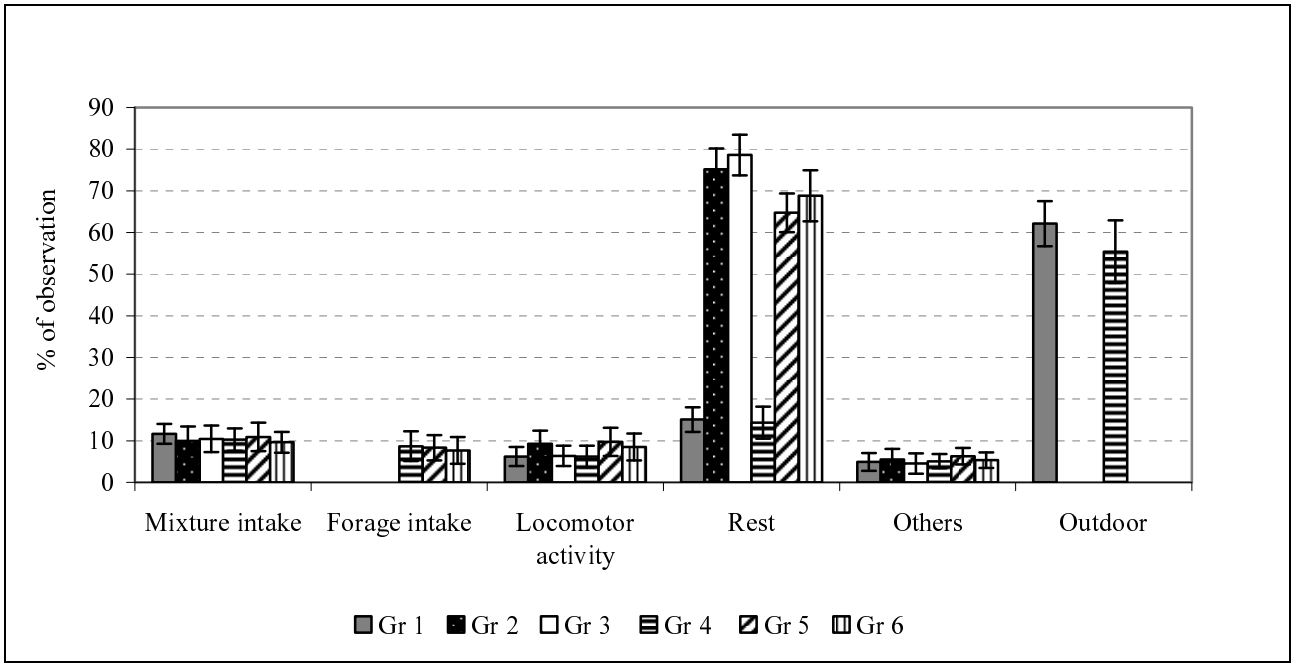

Fig. 2. **Behavior of fatteners at the final stage of observation** (100 kg b. w.)

At stage I of the experiment, pigs of group 6 reared indoors without straw bedding and fed with addition of alfalfa displayed the highest level of moving activity in the building (14.54%), while animals of group 4 kept outdoors and fed with alfalfa addition spent only 10.28% of their time actively. The total time devoted to moving activity was 37 to 52.3 min., and the average number of series varied between 3.9 and 5.3. At stage II of experiment, pigs of group 5 housed indoors with straw bedding and fed with addition of alfalfa were most active in the building (9.72%), whereas pigs of group 4 raised with outdoor runs access and without straw, fed with alfalfa addition were least active (6.20%). The number of series of moving activity ranged from 2.3 to 4.3.

At stage I, complete feed was most frequently (more than four times) consumed by pigs of group 3, kept indoors without straw bedding and fed a complete diet only. Animals of group 6, housed indoors and fed with addition of alfalfa, spent the most time ingesting food (40.7 min.). At the first stage of the study, pigs of group 4 spent least time eating (9.81%), while at the second stage – animals of group 6. The duration of other activities was comparable in all treatments at both stages of fattening.

As mentioned in the Materials and Methods section, the group of "other activities" included behaviours that were rarely encountered during 360 minutes of observation, such as a few cases of aggressive behaviour, play activity, exploration, physiological functions, etc. An analysis of the gathered behavioural data revealed that at the initial stage of fattening the animals spent less time resting and devoted more time to motor activities, including staying outside in the run. Younger animals responded more strongly to external stimuli and changes in environmental conditions.

Our results corroborate the findings of Dyrcz (1998) who noted considerable differences in pig behaviour depending on the housing system. In the cited study, pigs raised without straw bedding spent more time resting, were less active and more aggressive, in comparison with animals kept on deep straw.

Table 2. **Behaviour of fatteners in the second phase of fattening** (100 kg b. w.)

Specification	Stat.	Feeding on mixture			Feeding on mixture and alfalfa forage			SEM	Significance level	
		With access to outdoor runs (1)	Indoor +straw bedding (2)	Indoor without straw bedding (3)	With access to outdoor runs (4)	Indoor +straw bedding (5)	Indoor without straw bedding (6)		Rearing	Feeding
Mixture intake										
- number	x	3,9	4,0	3,1	3,7	4,5	3,5	0,14	NS	NS
of series	s	1,12	1,46	1,06	1,39	1,51	1,24			
- total time	x	42,0	36,0	37,7	37,0	39,3	34,7	1,12	NS	NS
	s	8,61	12,42	11,47	9,60	12,22	8,95			
Forage intake										
- number	x	-	-	-	2,4	2,5	2,4	0,15	NS	NS
of series	s	-	-	-	0,73	1,06	0,98			
- total time	x	-	-	-	31,3	30,0	27,6	1,80	NS	NS
	s	-	-	-	12,88	11,01	11,63			
Moving activity in the building										
- number	x	2,6	3,8	2,9	2,3	4,3	3,5	0,14	**	NS
of series	s	1,12	1,14	1,30	0,81	0,97	1,30			
- total time	x	$22,3^{B}$	$33,3^{A}$	$23,0^{B}$	$22,3^{B}$	$35,0^{A}$	30,6	1,21	**	NS
	s	8,20	11,44	8,82	9,42	12,10	11,63			
Time spending on outdoor runs										
- number	x	6,5	-	-	$5,6^{B}$	-	-	0,32	-	NS
of series	s	1,88	-	-	1,23	-	-			
- total time	x	$223,7^{A}$	-	-	$199,3^{B}$	-	-	10,7	-	NS
	s	19,50	-	-	27,11	-	-			
Rest in the building										
- number	x	$3,4^{BD}$	$6,0^{bC}$	$5,8^{B}$	$3,1^{BD}$	$7,5^{Aa}$	$4,9^{B}$	0,23	**	NS
of series	s	1,45	1,31	1,82	1,67	1,55	1,49			
- total time	x	$54,3^{B}$	$270,6^{AC}$	$283,0^{AC}$	$51,6^{B}$	$233,0^{ADb}$	$247,6^{ADa}$	10, 6	**	NS
	s	10,66	18,11	17,60	13,84	16,66	22,10			
Other activities										
- number	x	2,3	2,7	2,0	2,7	2,8	2,3	0,13	NS	NS
of series	s	1,39	1,33	1,06	1,11	1,08	1,22			
- total time	x	17,7	20,0	16,3	18,3	22,7	19,3	0,82	NS	NS
	s	7,76	9,06	8,76	6,17	7,28	6,79			

*, a, b – α = 0.05; **, A, B – α = 0.01; NS –not significant

Greater differences in the amount of time devoted to feed consumption in pigs were reported by Kozera (2007). The duration of feeding behaviour was 55 min. in indoor with access to outdoor runs pigs fed a complete diet, and 23 and 39 min. at the first and second stage of observation, respectively, in pigs raised indoors and fed a complete diet. In a study by Klocek et al. (2000), weaning pigs kept in deep-straw and strawless houses spent a shorter time feeding, 26 and 29 min., respectively.

Also in other studies (Dyrcz 1998, Kapelański et al. 2004, Kozera et al. 2009), resting had a high share of the total observation time in pigs reared indoors. In experiments performed by Kozera (2007), resting had the highest share of the total observation time in groups of pigs raised in confinement, while in indoor with access to outdoor runs pigs resting behaviour accounted for 29.4% to 49.2% of the total observation time.

Kozera (2007) studied pig behaviour under different housing and feeding systems and found that at the initial stage of fattening, younger animals spent less time resting and were more active, whereas the duration of resting increased and the duration of moving activity and other behaviours decreased towards the end of fattening. In a study of young animals, Klocek et al. (2000) noted that the amount of time devoted to moving activity was similar, regardless of the housing system. However, in animals kept in confinement without straw, frequent changes in behaviour, observed primarily at night, resulted probably from discomfort, in particular thermal discomfort. Weaners kept on deep straw were calmer and more relaxed and felt more comfortable. Weaners having access to straw spent more time engaged in play activity,

including digging and sniffing. Sterne and Andresen (2003) compared foraging behaviour patterns in outdoor pigs given 100 or 80% of the indoor recommended feed, foraging on a clover/grass pasture. The duration of passive behaviour was shorter than in our study, reaching 54.5% and 50.8%, respectively, while the time devoted to foraging was longer – 30.0% and 33.6%, respectively. The percentage of time spent resting, moving and feeding, recorded in our study, is consistent with the findings of other authors (Dyrcz 1998, Kapelański et al. 2004, Kozera et al. 2009, Kracht 1982). However, some of the cited authors carried out their observations both day and night. Dyrcz (1998) investigated the effect of the husbandry system and feeding frequency on production results and behaviour in growing-finishing pigs, and found that pig behaviour was not significantly affected by the number of servings, but it was influenced by the stage of fattening and the body weights of animals. Pigs kept on deep straw needed less rest, remained active for longer periods of time and exhibited less aggressive behaviours than pigs kept without straw bedding. The cited author concluded that pig behaviour is largely determined by the season and microclimate conditions inside the building, followed by housing system. Pen size becomes an important consideration at the end of fattening.

In a study of pigs conducted in Slovenia, wheat straw and hay (100 g/day/animal) were used as environmental enrichments, which significantly increased the proportion of total activity during daytime and significantly reduced the frequency of aggressive behaviours (Jordan et al. 2008).

As demonstrated by Hammermaister et al. (2004), lying was the predominant form of behavior in pigs raised in strawless houses – it accounted for 23.05% of all recorded activities. In pigs kept on deep straw, moving was the predominant form of activity (19.45%). The behavioural needs of the animals were better catered for in the deep-straw system.

Kapelański et al. (2004) reported that indoor with access to outdoor runs pigs spent 51.3% of their time resting, while physical activities accounted for 14.15% of the total observation time, including staying outside in the run (11.79%) and feeding (green forage – 7.81%, complete diet – 8.5%). According to some authors (Dyrcz 1998, Guy et al. 2002, Labroue et al. 1994), significant differences in pig behaviour may be due to genetic rather than experimental (environmental) factors.

Conclusions

The results of this study showed that:

1. The access to outdoor runs or feeding with addition alfalfa forage had a high significant (α=0,01) influence on reduction of resting time spent in the building and on the increase of moving activity of fatteners on both stages of experiment.

2. Pigs rearing with access to outdoor runs and feeding with addition alfalfa forage spent a high significant (α=0,01) less time outdoor on runs, in comparison to fatteners rearing outdoor and fed without an alfalfa forage, i.e. this forage could be treated as an element of environmental enrichment.

3. Straw bedding in pens for fatteners reared indoor had a significant (α=0.05 at first stage of fattening and α=0.01 in second stage of fattening) influence on increase of their moving activity, i.e. straw bedding was a factor of animal well-being.

4. An increase in rest periods and a reduction in moving activity were observed in older animals. At the first stage of experiment, fatteners spent less time resting and devoted more time to motor activities, including staying outside in the run. Younger animals responded more strongly to external stimuli and changes in environmental conditions.

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