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Effect of group composition on agonistic behavior and performance of newly mixed weaned pigs

JANA MAREKOVÁ, JANA KOTTFEROVÁ, MILOSLAV ONDRAŠOVIČ, OLGA ONDRAŠOVIČOVÁ, MILADA VARGOVÁ, LEON SABA*, BOŻENA NOWAKOWICZ-DĘBEK*, IVONA SVOBODOVÁ**, ANTON HVOZDÍK

Department of Environment, University of Veterinary Medicine, Komenského 73, 041 81 Košice, Slovak Republic
*Department of Animal and Environmental Hygiene, Faculty of Biology and Animals Breeding, University of Life Sciences, 13 Akademicka Str., 20-950 Lublin, Poland
**Department of Genetics and Breeding, Czech University of Life Sciences, Kamycka 129, 160 00 Praha 6 - Suchdol, Czech Republic

Mareková J., Kottferová J., Ondrašovič M., Ondrašovičová O., Vargová M., Saba L., Nowakowicz-Dębek B., Svobodová I., Hvozdík A.

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Summary

The objective of the present study was to compare the differences and regularities in social behavior of newly mixed piglets under the conditions of large-scale commercial pig production.

Three methods of grouping piglets at weaning (31-34d) into a 12-member weaned pool were studied: 6 pigs from 2 litters (6 × 2); 4 pigs from 3 litters (4 × 3); 3 pigs from 4 litters (3 × 4). Each method had three replicates and the weaned piglet body weight ranged from 7.4 up to 9.8 kg. Agonistic behavior was recorded over three observation periods: 0-1.5 h immediately after mixing; 1 h, 4-5 h later the same afternoon; 5 days later for 1 h. Both contact (head thrusting, biting and pushing) and non-contact (chasing, threatening and displacement) agonistic behavior were recorded. Contact behaviors made the most significant contribution to obtain a new dominance status in the social hierarchy and decreased significantly in frequency over time. Subsequently, the rate of non-contact behavior also declined. During the first observation period covering the crucial time for establishing dominance hierarchy, structure 4 × 3 had significantly less head thrust than 6 × 2 or 3 × 4. Generally, 4 × 3 showed a lower rate of contact behavior compared to the other two groups as well as less non-contact behavior than 3 × 4, but it was similar to 6 × 2. It appears that the 4 × 3 structure may cause less physical encounters than the other two groupings.

Keywords: pig, applied ethology, agonistic behavior, weaned

Behavior is a direct pig response to environmental conditions. Animals housed indoor without any possibility of choice demonstrate some specific behaviors that make the characteristic response to a given factor or behaviors which are reoriented towards better adaptation (13, 17).

Despite pig predisposition to interspecies aggression conditioned upon increased excitability, their social behavior is behaviorally consolidable by establishing a new social dominance hierarchy (8). The post-weaning mixing of unfamiliar pigs is a common practice in pig production. However, irrespective of a piglet weight and age, weaning is always associated with a stress and the younger and smaller the piglets, the greater the stress experienced (16).

Weaning in most units consists in separating the piglets from the sow and frequently commingling them with the other piglets from different litters, thus forming groups of the young of similar body weight. Mixing induces negative social behavior, which can result in skin damage and even death in hot weather (11). From the point of view of animal psychiatry, this maladaptive behavior of animals as a manifestation of their decreased adaptability could be termed as ethostasis, i.e. the potential state of development of abnormal behavior (7).

The aim of the study was to compare the differences in behavior and the regularities in the social behavior of newly mixed pigs under the conditions of large scale production.

Material and methods

The investigation included crossbred pigs (Large White Landrace) from a specific pathogen-free unit of 50 sows.

Three grouping methods were studied: 6 pigs from 2 litters (6 × 2); 4 pigs from 3 litters (4 × 3); 3 pigs from 4 litters (3 × 4). Each group had three replicates (36 pigs per group). Pig body weight at weaning ranged from 7.4 up to 9.8 kg. Upon weaning (31-34 days), the pigs were relocated from the farrowing section to the weaned pens (2 m × 1 m). The pens were equipped with solid floors (70%) and slotted – to allow manure and urine to pass through. Dry commercial pellets were given *ad libitum*. Ventilation was by natural air circulation rising from open side-shutters through a continuous ceiling rent. The temperature averaged from 16-27°C throughout the 6-month-study period (March-August).

Some direct observers performed all behavioral observations, while the animals appeared not to be disturbed by their presence. Thus, the frequency and type of agonistic behavior, including pushing, biting and head-thrusting (a pig vigorously pushes another one with the snout top) were recorded and subsequently classified as contact behaviors. Whereas, chasing, threatening and displacement from feeder, drinker or another area were also recorded, but recognized as non-contact behaviors. The pig initiating the behavior and the recipient were noted.

Agonistic behavior involved a conflict between animals and it was recorded for 1.5 h, immediately after the morning commingling (Period 1). The second observation period (the same day 4-5 h later) lasted for 1 h, whereas in Period 3 the 1-h observation was performed 5 days later. Changes in frequency and type of agonistic behavior occurring during 5 days could be studied then.

The weaning weight and weights after the 29d period were recorded, so that growth rates could be calculated (kg/days) and analysed using analysis of variance. The post-weaning growth-rate check should be recorded by 29 days. Behavior data were analyzed using a long linear model, the frequencies of behaviors per hour by analysis of deviance. The effects of litter grouping, behaviors, observation periods (1, 2 and 3) and interactions between them were studied.

Behavior correlated to a period and litter grouping when considered as contact/non-contact or as the 6 separate elements (head-thrusting, biting, pushing, chasing, threat and displacement), so each behavior and contact/non contact grouping was analysed separately. All the 8 analyses exhibited a litter-grouping × period interaction. The estimates of standard errors from this analysis, and the natural logarithm of frequencies, t-tests were applied to compare the 9 litter-groupings × observation periods for each behavior and contact/non contact grouping.

Results and discussion

There were no significant differences observed in growth rates during 29 days (fig. 1). Variation within the groups appeared high for the groups 4 × 3 and 3 × 4.

The number of behaviors per hour at each period (1, 2, 3) for 3 replicates of each group structure are presented in tab. 1-2 and fig. 2. The raw data are given in fig. 1 and the re-transformed means, showing all the significant differences ($p < 0.05$) are shown in

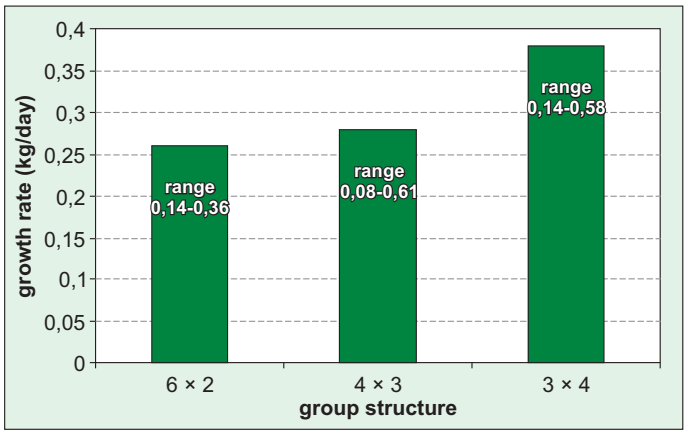

Fig. 1. Mean growth rates and ranges for groups containing 6 pigs from 2 litters (6 × 2), 4 pigs from 3 litters (4 × 3) and 3 pigs from 4 litters (3 × 4)

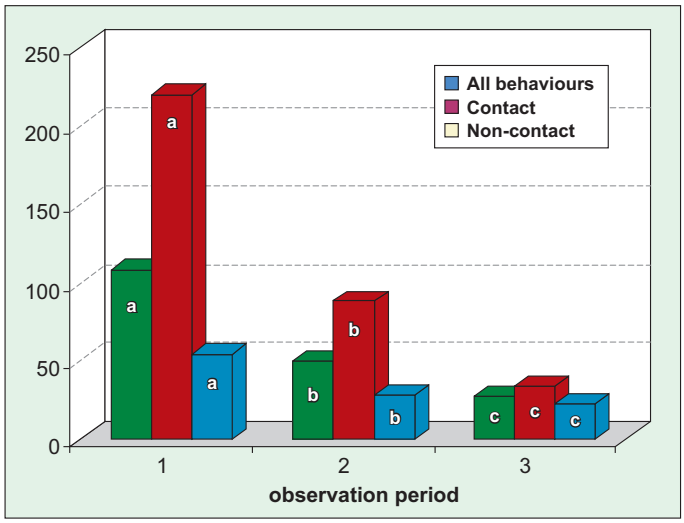

Fig. 2. Behaviors frequency per hour (re-transform an means of natural logarithms) during each of the three periods of observation

Explanation: significant differences ($p < 0.05$) between observation periods denoted by different letters

fig. 2 and tab. 2. Generally, the first observation period recorded significantly more agonistic behaviors than the other two (fig. 2).

The agonistic behaviors were then considered as either contact (head-thrusting, biting, and pushing) or non-contact (chasing, threat and displacement) behavior. Regardless of the group structure, the frequency of contact behaviors during the first observation proved to be significantly higher as compared to the second and third observation periods (fig. 2). The number of non-contact behaviors noted during Period 1 was also significantly greater than in Period 2 and 3. The number of contact behaviors in each period also differed significantly from the non-contact behaviors during the same period (fig. 2).

Period 1 contact and non-contact behaviors were compared with those of Period 2 and 3. Contact behaviors turned out to be the least frequent in Group 4 × 3 during Period 1 and 2, but the frequency did not decrease any further in Period 3. The frequency of

Tab. 1. Number of behaviors per hour at each time period (1, 2, 3) for 3 replicates of each group structure: 6 pigs from 2 litters (6 × 2); 4 pigs from 3 litters (4 × 3); 3 pigs from 4 litters (3 × 4)

Behaviors	Group structure								
	6 × 2 Period			4 × 3 Period			3 × 4 Period		
	1	2	3	1	2	3	1	2	3
Contact									
Head thrusting	298	143	59	206	86	134	297	126	36
Biting	290	205	17	283	78	22	506	102	8
Pushing	61	35	6	23	15	14	22	9	11
Non-contact									
Chasing	39	30	2	31	11	15	98	18	2
Threat	67	49	42	79	14	78	118	64	19
Displacement	15	54	9	7	5	14	22	15	24

Tab. 2. Behavior frequency per hour (re-transforment of natural logarithms) in litter groups during each of the three periods of observation

Behavior category	Group structure								
	6 × 2 Period			4 × 3 Period			3 × 4 Period		
	1	2	3	1	2	3	1	2	3
Contact	216.3	127.7	27.3	168.3	59.4	56.3	273.4	78.3	18.4
Non-contact	41.0	42.0	17.1	41.3	94.1	36.0	78.7	31.3	15.7
Head-thrust	99.1	48.3	19.3	69.3	29.7	44.4	99.3	41.7	11.7
Biting	96.4	69.0	5.3	98.3	28.1	7.1	168.3	32.7	11.8
Pushing	20.0	12.3	1.8	7.3	4.8	4.3	72.3	3.0	3.3
Chasing	13.0	6.8	0.4	10.0	3.4	4.7	32.3	5.7	0.8
Threat	22.1	16.4	13.7	27.0	39.0	21.0	39.3	21.0	6.3
Displacement	5.0	18.1	3.1	2.0	4.3	4.4	7.1	4.7	7.7

non-contact behaviors was relatively low in all periods, although group 3 × 4 showed a higher frequency as against the other two groups in Period 1.

In all the groups, head-thrusting and biting occurred more frequently in Period 1 than during Period 2 and 3. Pushing behavior declined significantly at Period 3 (tab. 2). The non-contact behaviors tended to decrease over time, but in group 4 × 3 no significant change over time in chasing behavior was noted.

The first observation period (Period 1) is crucial for the social hierarchy establishment, so the behaviors of each group structure during period 1 were analyzed. The percentage of contact behaviors over the total interactions during Period 1 were as follows: Group 6 × 2, 85%; group 4 × 3, 76%.

Group 4 × 3 had significantly less head-thrusts than group 6 × 2 or 3 × 4; group 6 × 2 or 3 × 4; biting was significantly higher in group 3 × 4 than in group 6 × 2 and 4 × 3; while group 6 × 2 demonstrated significantly more pushing behavior than groups 4 × 3 and 3 × 4.

In the non-contact behaviors during Period 1, group 6 × 2 and 4 × 3 were significantly lower than group 3 × 4 in chasing and threat behavior, but there were no differences observed between the groups in disablement behaviors. For the total of the 3.5-h observation over the 5-d period, group 4 × 3 showed 1416 agonistic behaviors compared with 1798 and 2015 in group 6 × 2 and 3 × 4, respectively.

Analysis of deviance confirmed that for all the groups no significant differences in the contribution of a particular litter to each treatment studying the hierarchy formation during the 5-d period were observed.

The mixing of newly weaned piglets is a well-known stressor and a widespread procedure in pig production. Piglet commingling affected the hourly distribution of the drinking activity (2, 10). Horvath et al. (6) reported that piglets grew faster if they were not regrouped. The avoidance of animal mixing that brings about their severe behavioral disturbance would be beneficial as regards pig welfare as well as their performance. Ekkel et al. (4) compared specific-stress-free housing to a conventional housing system, where the pigs were mixed at weaning. The authors reported high levels of aggression displayed by piglets as the post-commingling behavior resulting in ear, skin and tail lesions. The saliva cortisol concentration appeared to be lower in the stress-free housing pigs after weaning. Ekkel et al. (3) described an experiment carried out to evaluate the effects of pigs mixing. They found a higher frequency of agonistic interactions exhibited by the mixed pigs. This was not only the case immediately after mixing, when pigs started to fight to establish a new social rank, but 5 to 6 wk later as well. Moreover, more head knocks and bites towards other pigs were observed over time among the commingled pigs.

The contact agonistic behaviors, head-thrusting, biting, and pushing, contribute most to hierarchy formation. Over the 5-d period of our observations, the contact agonistic behaviors were recorded more frequently than the non-contact behaviors of chasing, threat and displacement.

The most vigorous interactions occurred in the first 1.5 h immediately after mixing. Overall, the group 4 × 3 replicates had the lower rate of contact agonistic interactions than the other two structures. Groups 6 × 2 and 4 × 3 showed less chasing and threat encounters than group 3 × 4 and all groups were similar in disablement behaviors.

Both contact and non-contact behaviors decreased over the observation periods. The study of individual contact behaviors revealed that head-thrusting and biting decreased in all groups, but pushing persisted at the same level in groups 4 × 3 and 3 × 4. It can be argued that pushing does not cause any physical injury, but in groups 4 × 3 and 3 × 4 the probability of encountering an unfamiliar animal (0.74 and 0.83, respectively) was much higher than in group 6 × 2 (0.56).

It could be suggested that the higher rate of contact behaviors might be needed to maintain a pig's position in the social hierarchy. The results of Otten et al. (14) show that during a social confrontation, the experience of high-ranking pigs is accompanied by an increased submissive or passive behavior and a higher sympathoneural and adrenomedullary reaction, which may indicate emotional distress and fear as compared to a successful animal.

Meese et al. (12) found that the dominant pig was identifiable by an observer within 30-60 min, and that dominance order was established within 48 h. The initial peak of aggression was found to be due almost entirely to the animal which became dominant. The levels of aggression dropped dramatically about 1 h after unacquainted pigs mixing. The stressor associated with commingling may cause some physiological changes, such as higher plasma cortisol concentrations in non-litter male pigs re-grouped at weaning (1). The metabolic state changed in response to the encounters, as evidenced by increased plasma levels of free fatty acids, glucose and lactate (5, 9). The results of Otten et al. (15) show that agonistic behavior and activation of the sympatho-adrenomedullary and the hypothalamic-pituitary-adreno-cortial system in pigs during a social confrontation are determined by the former dominance rank of the animals.

However, because the total number of agonistic behaviors was lower for group 4 × 3 replicates (1416) than for group 6 × 2 (2015), and the group 4 × 3 structure had less head-thrusting than the other two structures, similarly less pushing and biting compared to the group 3 × 4 structure, the 4 × 3 structure can be recommended. Interestingly, this structure (4 piglets from each of 3 litters) has been indicated by some farmers as showing less „fishing" than the more or fewer mixed litters. Mixing piglets from three litters at weaning resulted in less agonistic behavior than commingling pigs from two or four litters at any one time.

References

1. *Deguchi E., Akuzawa M.*: Effects of fighting after grouping on plasma cortisol concentration and lymphocyte blastogenesis of peripheral blood mononuclear cells induced by mitogens in piglets. J. Vet. Med. Sci. 1998, 60, 149-153.
2. *Dybkjaer L., Jacobsen A. P., Togersen F. A., Poulsen H. D.*: Eating and drinking activity of newly weaned piglets: effects of individual characteristics, social mixing, and addition'of extra zinc to the feed. J. Anim. Sci. 2006, 84, 702-711.
3. *Ekkel E. D., Savanije B., Shouten W. G., Wiegant V. M., Tielen M. J.*: The effects of mixing on behavior and circadian parameters of salivary cortisol in pigs. Physiol. Behav. 1997, 62, 181-184.
4. *Ekkel E. D., van Doorn C. E., Hessing M. J., Tielen M. J.*: The Specific-Stress-Free housing system has positive effects on productivity, health, and welfare of pigs. J. Anim. Sci. 1995, 73, 1544-1551.
5. *Fernandez X., Meunier-Salaun M. C., Mormede P.*: Agonistic behavior, plasma stress hormones, and metabolites in response to dyadic encounters in domestic pigs: interrelationships and effect of dominance status. Physiol. Behav. 1994, 56, 841-847.
6. *Horvath G., Jaczkone Jarabin I., Visnyei L.*: Effects of regrouping, feeding and drinking methods on weight gain of weaned piglets. Dtsch. Tierärztl. Wschr. 2000, 107, 364-367.
7. *Hvozdík A.*: Ethological study of social behavior of pigs after negative experience in early onthogenesis. Folia Vet. 1997, 41, 131-134.
8. *Hvozdík A., Kottferová J., Alberto S. J.*: Ethological study of social behavior of pigs from the point of view of housing restriction. Arch. Tierz., Dummerstorf 2002, 45, 557-563.
9. *Koréneková B., Skalická M., Jacková A.*: Minerálne látky a životné prostredie. Informačný spravodajca KVLSR 2004, 13, 13-14.
10. *Liorančas V., Bakutis B., Januškevičienė G.*: Influence of rearing space on the behavior, performance, carcass and meat quality of pigs. Medycyna Wet. 2006, 62, 274-277.
11. *McGlone J. J., Kelly K. W., Gaskins C. T.*: Lithium and porcine aggression. J. Anim. Sci. 1981, 51, 447-455.
12. *Meese G. B., Ewbank R.*: The establishement and nature of the dominance hierarchy in the domestic pig. Anim. Behav. 1973, 21, 326-334.
13. *Novák P., Kubíček K., Odehnal J., Beňová K.*: Tvorba prostredí chovu a řesení problému vlivu chovu zvířat na životní prostředí v České republice. In Sborník referátu Tvorba mikroklímy v ustajňovacích objektoch a vplyv chovu zvierat na životné prostredie. VÚŽV Nitra 2002, 45-59.
14. *Otten W., Puppe B., Kanitz E., Schon P. C., Stabenow B.*: Effects of dominance and familiarity on behavior and plasma stress hormones in growing pigs during social confrontation. Zntbl. Vet. Med. A 1999, 46, 277-292.
15. *Otten W., Puppe B., Kanitz E., Schon P. C., Stabenow B.*: Physiological and behavioral effects of different success during social confrontation in pigs with prior dominance experience. Physiol. Behav. 2002, 75, 127-133.
16. *Rushen J., Passille A. M., Ladwg G. J., Foxcroft G.*: Effects of stress on maternal behavior in pigs. Proc. 28th Internat. Congress ISAE, Foulum, Denmark 1994, 35, 25-31.
17. *Walczak J., Herbut E.*: Behavior of growing pigs as an expression of their physiological response to different welfare levels. Proc. ISAH, Mexico 2003, p. 120-124.

Author's address: DVM Jana Mareková, University of Veterinary Medicine, Komenského 73, 041 81 Košice, Slovak Republic; e-mail: jana.marekova@yahoo.co.uk