Contribution of Rearing at Pasture on Improvement of Animal Welfare in Fattening Pigs

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Introduction

Maintaining the health of animals is an important part of livestock management. Ensuring good health of livestock has several benefits. Not only does it help prevent economic losses for farmers (e.g. the cost of treating diseased animals), it also protects human health by reducing the chances of zoonotic infections and providing a better guarantee of food. As animal health and animal welfare are closely related, World Organisation for Animal Health (OIE), which supervises animal health worldwide, has emerged as the leading international organization for animal welfare (OIE, 2014). OIE has six primary objectives that include ensuring food safety and improving animal welfare. This has led to a better guarantee of animal products, as ensuring animal welfare during livestock management has recently become a global standard for farmers.

Rearing of pigs at pastures is expected to improve animal welfare (FAWC, 1996). However, there is a possibility of deterioration in physical health given by the severity of outdoor environment. To understand the contribution of rearing at pasture on improvement of animal welfare, we compared the behavior, physical health, and productivity of fattening pigs reared in an outdoor pasturing system compared to an indoor intensive system.

Behavior

To compare the behavior of pigs between rearing systems, two treatments were prepared, reproduction of rearing systems as an outdoor pasturing system (OP) and an indoor intensive system (IS) (Tozawa *et al.,* 2016b). OP had an open-air roofed pen (1.2 m^2/head) and a pasture (200 m^2). IS had a pen, similar to OP, but no associated pasture. OP and IS treatments were in the same field to ensure similar air condition and temperature. Four castrated males (LW breed) were offered to each treatment. They were introduced to the treatment at 87 days of age and reared until they were 193 days old. When the pigs were 124 days old, the rearing site for OP was changed to an adjacent pasture of similar size due to depletion of grass in the previous pasture. Feed and water were available *ad libitum* and the same feed concentrate was provided in both treatments. Maintenance behaviors and behavior as events (Table 1) in the pigs were observed at 21 weeks of age.

Table 2 shows the time budget of maintenance behaviors in pigs. The time budget for foraging, which included the feeding, grass eating, and soil eating time was 19.9 ± 3.5% (mean ± SD) in OP and 12.7 ± 1.0% in IS (P = 0.03). The time budget for the feed concentrate was the same for OP and IS pigs, whereas OP pigs had a higher grass eating and soil eating budget. This resulted in a significantly higher foraging time for OP pigs than the IS pigs. In addition, OP pigs had a 3.7-fold higher exploration time compared with IS pigs (P = 0.03). Finally, this higher expression of foraging and exploring in OP pigs was associated with increased activity. Pig is an inquisitive animal that shows a highly motivated exploring behavior (Wood-Gush *et al.,* 1990). If pigs are reared in an unstimulating environment, they tend to be apathetic (Ruiterkamp, 1987) and undergo chronic stress (Beattie *et al.,* 2000). Barren environments also appear to have pronounced effects such as impairment of cognitive function and increased fearfulness in pigs (Beattie *et al.,* 2000). The outdoor pasturing system could have provided a stimulating environment, because of which, the pigs showed a high exploration and active behavior, leading to their improved welfare.

Table 1. *Ethogram of maintenance behavior and behavior as events.*

Behavior	
Maintenance behavior	
Foraging	Total time of feeding, grass eating and soil eating
Feeding	Gathering, chewing and swallowing concentrate
Grass eating	Chewing and swallowing fresh grass in pasture
Soil eating	Chewing and swallowing soil in pasture
Exploring	Sniffing surrounding environments, rooting, chewing rocks
Activity	The time except resting
Behavior as events	
Agonistic behavior	Head butting or aggressive biting at other pen mates
Affilative behavior	Smelling, licking other pen mates
Chewing	Chewing action with if the objects (grass, soil, or food) were seen in the pigs' mouth
Rooting	Back-and-forward movement of the snout over soil, but not pen mates
Disturbed behavior	Chewing or rooting pen mates, chewing or biting facilities, sham-chewing
Play	Bouts of chasing, fight with others, play at a puddle

Modified from Tozawa *et al*. (2016b)

Table 2. *Time budgets of maintenance behavior of pigs.*

	Rearing system[1]		
	OP	IS	*P*-value[2]
Foraging	19.9 ± 3.5	12.7 ± 1.0	0.03
Feeding	12.7 ± 2.7	12.7 ± 1.0	0.69
Grass eating	5.2 ± 1.6	0	0.01
Soil eating	2.1 ± 0.6	0	0.01
Exploring	12.2 ± 1.0	3.3 ± 0.8	0.03
Activity	45.2 ± 6.7	25.7 ± 4.0	0.03

Modified based on Tozawa *et al*. (2016b)

Value are expressed as mean ±S.D.% in the observation period

[1]OP: Outdoor pasturing system, IS: Indoor intensive system

[2]Mann-Whitney U test

Table 3. *Frequencies of behavioral as events of pigs.*

	Rearing system[1]		
	OP	IS	*P*-value[2]
Agonistic behavior	1.6 ± 0.6	1.7 ± 0.9	0.77
Affilative behavior	0.7 ± 0.8	1.1 ± 0.4	0.45
Rooting	13.9 ± 6.0	0	0.01
Chewing	19.4 ± 3.6	0.3 ± 0.3	0.02
Disturbed behavior	0.7 ± 0.8	8.3 ± 5.9	0.02
Play	0.7 ± 1.0	0	0.05

Modified based on Tozawa *et al*. (2016b)

Value are expressed as mean ±S.D. (Expression times / h)

[1]OP: Outdoor pasturing system, IS: Indoor intensive system

[2]Mann-Whitney U test

Table 3 shows the frequencies of behavior as events of pigs. Agonistic behavior and affiliative behavior had any significant difference between the treatments. These social behaviors were exhibited equally, regardless of the rearing system. The expression of chewing grass, soil, or concentrate was 19.4 ± 3.6 times/h (mean ± SD) in OP pigs and 0.3 ± 0.3 times/h in IS pigs (P = 0.02). Rooting soil behavior using the nose was expressed 13.9 ± 6.0 times/h in OP pigs but had no expression in IS pigs (P = 0.01). When pigs do not get access to substrates for expressing chewing, rooting, and snouting, these exploratory behaviors are often redirected towards pen-mates and facilities (Peterson *et al.,* 1995; Beattie *et al.,* 2000). Such redirected behavior is one of the most severe problems for pigs reared in an intensive system, leading to body wounds (e.g., tail biting) or destruction of facilities. IS pigs expressed disturbed behavior 11.9 times more than the OP pigs (P = 0.02). In addition, IS did not express any playing behavior whereas the OP pigs expressed it 0.7 ± 1.0 times/h (P = 0.05). Disturbed behavior, including redirected behavior, is indicative of mental conflict in pigs that could not express enough of their natural behavior. In contrast, playing behavior accompanies a positive emotion such as enjoyment (Olsen *et al.,* 2002). Pasture rearing not only results in a natural and active behavior of pigs, but they also express less behavior-associated stress and more behavior accompanies positive emotion, leading to improved overall welfare.

Physical health

Physical health is an important component of animal welfare. Lesions of lung disease and wounds on the body were examined for estimating physical health.

One of the health problems in intensive system of fattening pigs is the lung disease. In particular, Mycoplasmal pneumonia of swine (MPS) is quite common and its infection rate is extremely high worldwide. Improving the air condition suppresses the damage of lung by MPS (Yagihashi *et al.,* 1993). Therefore, we hypothesized that the outdoor conditions of pasture might have an effect on it. The number of affected pigs and the percentage invasiveness of MPS lung lesions were observed (Tozawa *et al.,* 2016a) using an established scoring system (Goodwin and Whittlestone, 1973). The observed pigs were introduced from the same farm, but reared in different systems, 2 outdoor pasturing systems and an indoor intensive system, with 14 pigs per system. The number of affected pigs (P = 0.06) and the percentage invasiveness of MPS lung lesions (P = 0.51) did not show any difference between the rearing systems. The main difference between the rearing systems was the air condition, which depended on the availability of an outdoor environment. As no difference was observed between the rearing systems, these traits might instead depend on the disease management strategy at the introducing farm.

Wounds on the body for the same pigs that were reared at OP and IS for behavioral observations, were scored using Welfare Quality® assessment protocol (Welfare Quality® Consortium, 2009) before shipping (Tozawa et al., 2016b). The score for OP pigs was 6.3 ± 4.6 points (mean ± SD) whereas that of IS pigs was 47.5 ± 22.7 points (P = 0.03). The occurrence of body wounds increased with an increased expression of aggression or disturbed behavior from other pigs. The OP pigs expressed less disturbed behavior and behaved naturally. As a result, they had less behavior-related stress. Satisfactory expression of natural behavior could be the cause of lower wound score in OP pigs. Severe body wounds increase the risk of infection, and result in reduced weight gain because of pain-associated appetite loss (Schrøder-Petersen and Simonsen, 2001). Fewer wounds in OP pigs would reduce the chances of infection and keep them healthy, in addition to increasing the productivity.

Productivity

Body weight of pigs and skatole (one of the meat constituents that affects its smell) were measured for estimating productivity.

Body weight was measured for the same pigs that were reared at OP and IS for behavioral observations. When they were introduced into the treatment, OP pigs weighed 32.9 ± 1.1 kg (mean ± SD) and IS pigs weighed 36.0 ± 1.1 kg. OP pigs were significantly lighter than the IS pigs (P = 0.04). However, OP pigs grew to 119.9 ± 4.6 kg and IS pigs grew to 119.3 ± 11.5 kg before shipping, and there was no significant difference between the two groups (P = 0.57). The average daily gain (ADG) was calculated during at the prior period (from introduction to treatments until reaching around 70 kg of weight) and the latter period (from around 70 kg to 100 kg of weight) (Tozawa *et*

al., 2016b). During the prior period, the ADG for OP pigs was 0.68 ± 0.18 kg/d and that of IS pigs was 0.76 ± 0.23 kg/d, with no significant difference (P = 0.70). In contrast, the ADG in OP (0.91 ± 0.09 kg/d) tended to be higher than in IS (0.67 ± 0.15 kg/d) during the latter period (P = 0.06). In other words, pigs reared in pasture showed a greater increase in body weight during the latter fattening period. These results show a difference between pigs reared in pasture and pigs reared in an indoor intensive system with respect to their growth period. The concern that OP pigs might lose weight by virtue of being more active than IS pigs was found to be untrue, as the body weights did not differ at the time of shipping.

The meat of pasture-reared pigs is considered less smelly than the meat sold in general, but there is not enough scientific evidence in this regard. A strong smell might affect the consumers' interests in buying the meat. Skatole is an aromatic compound that absorbed from the gastrointestinal tract, skin or lung (Hansen *et al.,* 1994). Skatole in the backfat of 9 pigs (5 reared in pasture and 4 reared in indoor intensive system) was analyzed. The proportion of animals with less than 0.01 ppm concentration of skatole in backfat was 4 out of 5 for pasture-reared pigs and 2 out of 4 for indoor intensive system pigs (Tozawa *et al.,* 2016a). A study on pigs raised in commercial farms reported that only 4 of 128 pigs had a fat skatole concentration lower than 0.01 ppm (Nishioka *et al.,* 2011). In comparison, the proportion of pasture-reared pigs with a skatole concentration in backfat lower than 0.01 ppm was remarkably large. According to a report based on sensory tests, the range of values for which people can smell skatole was 0.008-0.060 μg/g (Annor-Frempong *et al.,* 1997). Smell perception can vary among individuals as it is a sensitive ability. Even a concentration of skatole as low as 0.01 ppm could affect the consumers' preferences. The effect of pasture rearing on the flavor of meat could be considered as small, as there was a low concentration of skatole in the backfat of pasture-reared pigs.

Conclusion

Comparing between pigs reared in an outdoor pasturing system and an indoor intensive system, pigs reared at the pasture behaved more naturally and acted with positive emotion. These results show that satisfactory expression of natural behavior leads to a decrease in psychological conflict. Furthermore, pigs at the pasture maintained a better physical health due to fewer wounds on the body. Rearing pigs at the pasture improved the welfare not only improving by leading mental health, but also maintained physical health. In addition, there is a possibility of added benefit as the meat might not have a strong smell.

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