EXPERIMENTAL EVALUATION OF TWO HUSBANDRY METHODS FOR GROWING-FINISHING PIGS

Bénédicte Lebret[1], Marie-Christine Meunier-Salaün[1], Nadine Guingand[2], Paul Robin[3], Mélynda Hassouna[1,3], Roland Cariolet[4], Eric Dransfield[5] and Jean-Yves Dourmad[1]

[1]INRA UMR VP, 35590 Saint-Gilles, [2]ITP, 35651 Le Rheu, [3]INRA UMR SAS, 35044 Rennes; [4]AFSSA, 22440 Ploufragan; [5]INRA SRV, 63122 Theix, FRANCE

Introduction

A rejection of the conventional pig production system by the society has been occuring for few years, because it is generally associated with a negative environmental impact (problems of pollution and offensive odours), a poor animal welfare (due to high animal densities and bad housing conditions) and could be involved in a reduced meat quality. This feeling is observed in areas of high pig production density and also in areas showing a low pig farm density but a high potential for the development of pig production. Thus, in the near future, the pork chain has to propose different types of pig production systems that satisfy the consumer and citizen demands : lower environmental impact, better animal welfare and meat quality. The present study is set in this general objective, and aims to evaluate the effects of two contrasted pig husbandry methods on animal performance, welfare, health, environmental impact, and meat quality.

Material and Methods

Animals and husbandry. The experiment included a total of 120 synthetic line x (Large White x Landrace) pigs (castrated males, CM and females, F), all free of the n and RN$^-$ alleles. At an average live weight (LW) of 35 kg, littermates were allocated to either a conventional (totally slatted floor, 0.65 m^2/pig, controlled ambient temperature at 22°C considered as control, **C**), or a alternative system (**O**) : sawdust-shave bedding (1.3 m^2/pig, fluctuating ambient temperature) with free access to an outdoor area (concrete floor, 1.1 m^2/pig). Pigs were fed *ad libitum* growing (up to 70 kg) and finishing diets, and had free access to water. Trials were undertaken in spring, summer and winter, each involving 2 pens of 10 pigs (5 CM and 5 F) per system. Pigs were reared in two different rooms (one per system) of the same building.

Pig behaviour. At the average LW of 70 kg, the different activities and number of pigs implicated were evaluated every 10 min from video tapes recorded continuously over 24 hours. Time-budget (%) from 8 am to 4 pm were established for each husbandry method (see Lebret *et al* 2004 for more details on materials and methods).

Evaluation of environmental impact. At the end of each replicate, effluents were collected, weighted and analysed for dry matter (DM), nitrogen, phosphorus, potassium, copper and zinc. In each room, air flow was measured 4 times a week, and a determined sample of extracted air was continuously collected in sulfuric acid for subsequent ammonia determination. Four samples of extracted air were taken (replicates 1 and 2) for determination of dust level and odour concentration (olfactometry).

Slaughter and carcass traits. Pigs were slaughtered at around 114 kg LW, by groups of 5 pigs per system and slaughter date. After overnight fasting, transportation (2 hrs) and lairage (3hrs), pigs were slaughtered by electrical stunning and exsanguination. Blood was collected for determinations of plasma lactate, cortisol and ACTH (RIA). Severity scores of nasal cavities, lungs and stomach were evaluated to determine the occurrence of respiratory tract pathologies and ulcers, respectively. Carcass weight, mean back fat depth and lean meat content (calculated from linear measurements) were measured on the day of slaughter.

Meat quality. pH_1, pH_u, colour (L*a*b*) and lipid content were determined on *Longissimus lumborum* (LL), *Biceps femoris* (BF) and *Semimembranosus* (SM) muscles. LL drip losses were evaluated at 4 days p.m. Loins were kept at 4°C for 4 days, put under vacuum and frozen (-20°C) until sensory analyses. After thawing at ambient temperature, chops were grilled (double contact grill, 280°C, 6 min.) and assessed for odour, tenderness, juiciness and flavour on a scale from 0 (absent) to 10 (high) by a 10-member trained taste panel.

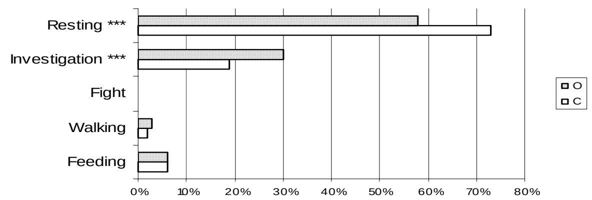
Statistical analyses. Data were submitted to an analysis of variance (GLM procedure, SAS), including the effects of husbandry method, season and sex. Slaughter date intra-replicate was added to the model for the analysis of stress at slaughter and meat quality variables. Time-budgets were compared using the χ^2 test.

Results and Discussion

Housing conditions. In the C system, the average ambient temperature was 23.5 (±1.0)°C. It was lower with higher fluctuations in O system : 12.0 (±4.0)°C and 18.8 (±2.7)°C in outdoor and indoor areas, respectively. Temperature differences between the C and outdoor and indoor areas of the O system were the highest in winter, the lowest in summer, and intermediate in spring.

Behavioural observations. The O pigs spent on average 24% of time outdoor. During daytime they exhibited a higher exploratory behaviour than C pigs, and spent less time resting (Fig. 1). Although pen wall and floor were the main structures investigated by the pigs in both systems, the O pigs spent 25% of their exploratory time manipulating the bedding, and exhibited less exploration behaviour towards others (25% *vs* 43% of time for O and C pigs, resp^{ly}., p<.05). These results, in agreement with Lyons *et al* (1995) and Beattie *et al* (2000), suggest that the O system would improve pig welfare.

Figure 1. Time-budget (%) during daytime (8 am-16 pm)



Environmental impact : effluents, air quality. Around 199kg bedding/pig (44.7% DM) and 228kg slurry/pig (outdoor area) were collected in the O system, compared to 366kg slurry/pig (9% DM) in the C system. The respective levels of potassium (mainly released by urine) and phosphorus, copper and zinc (mainly released by faeces) in the slurry from indoor and outdoor areas of the O system indicated that about 61% of urine and 44% of faeces were excreted in the indoor area, whereas pigs spent there about 76% of time. Air dust level and ammonia volatilization were similar, whereas the level of offensive odours was strongly decreased in the O compared with C system (Tab. 1).

Table 1. Air quality in indoor areas of C and O systems

	O	C
Dusts, mg/m^3	2.0 $\pm$ 0.6	1.5 $\pm$ 0.8
Ammonia, g/pig/d	10.8 $\pm$ 3.6	12.6 $\pm$ 5.0
Odours, U/pig/d	$5.6\ 10^5 \pm 4.5\ 10^5$	$19.0\ 10^5 \pm 13\ 10^5$

Growth performance. Compared to the C, O pigs had higher feed intake, growth rate and were heavier at slaughter at 155d, but mean feed conversion ratio did not differ between groups (Tab. 2). In the O system, the lower average ambient temperature may explain the higher feed intake and, consequently, the higher growth rate although the decreased competition among pigs (resulting from the increased space allowance), may also have been involved. The higher growth performance of O pigs agrees with results of Lyons *et al* (1995) and Beattie *et al* (2000).

Table 2. Effect of husbandry method on growth, carcass traits, animal health and performance meat quality traits

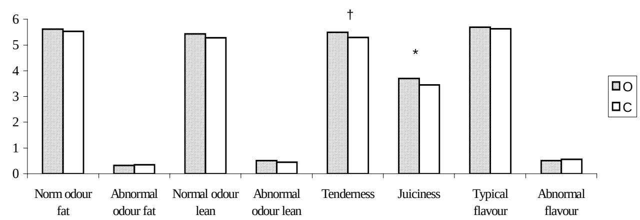
	O	C	Sign.
Number of animals	120	120	
Growth performance			
Final LW, kg	119.0	110.6	***
Feed intake, kg/d	2.94	2.71	**
Growth rate, g/d	1045	960	***
Feed conversion ratio, kg/kg	2.82	2.83	ns
Carcass traits			
Mean back fat depth, mm	20.9	18.5	**
Lean meat content, %	59.2	61.2	***
Health evaluation			
Nasal cavities (note/14)	0.7	2.0	***
Lungs (note/28)	2.5	3.5	ns
Stomach (note/7)	1.3	1.7	ns
Meat quality traits (LL)			
pH_1	6.37	6.42	ns
pH_u	5.50	5.49	ns
Colour L*	55.2	54.2	ns
a*	5.8	5.5	ns
b*	5.7	5.0	**
Drip loss, %	5.7	4.6	**
Lipid, %	1.68	1.44	**

Carcass traits and health at slaughter. The O system gave fatter carcasses (Tab. 2), in particular for CM compared to F pigs (p=.12). When adjusted to the same slaughter weight, differences in carcass traits between groups remained high and highly significant, suggesting that our observations are not the consequence of the heavier LW of the O pigs at slaughter, but resulted from a direct effect of the husbandry method. These findings are in agreement with Beattie *et al* (2000), whereas Van der Wal *et al* (1993) and Lyons *et al* (1995) did not report any significant effect of husbandry method on carcass fatness.

At each season, O pigs had lower severity scores of nasal cavities (Tab. 2) and we observed more uninjured O than C pigs (62 *vs* 38%). On average, lung scores were similar but they were lower for the O pigs at the winter replicate (3.6 *vs* 7.1/28, p<.05). Occurrence of stomach ulcers was low and similar in both groups. Altogether, this shows that, in our experimental conditions with a good health status, the O husbandry method led to less respiratory problems, in particular in the upper respiratory tract.

Reactivity of pigs to stress at slaughter and meat quality. Plasma ACTH, cortisol and lactate levels (not shown) and pH_1 of the 3 muscles (Tab. 2; SM and BF not shown) were similar between groups, suggesting that in our conditions, the husbandry method did not influence reactivity of pigs to stress at slaughter. The O rearing system had no effect on pH_u, meat lightness (L*) and redness (a*), but increased yellowness (b*) and drip losses in the LL. By contrast, we noticed a lower pH_u in the SM (5.50 *vs* 5.57, P<.001) and BF (5.49 *vs* 5.52, P<.05) muscles from O than from C pigs, suggesting that the effects of husbandry method on muscle metabolic traits are muscle-specific. In all 3 muscles, lipid content was higher in O than C pigs, in particular for CM. Meat from the two groups exhibited higher normal flavour score and did not show any abnormal flavour (Fig. 2). The O husbandry method increased loin juiciness and tended to increase tenderness (p=.08), however differences were small and may not be noticeable in a domestic situation. The other eating quality traits were not influenced by the husbandry method. Van der Wal *et al* (1993) did not report any significant effect of pig housing system on meat eating quality.

Figure 2. Effect of husbandry method on eating quality.



Conclusion

Compared to the conventional, the alternative husbandry method evaluated here led to : 1) an improvement in animal welfare as evaluated by animal behaviour and health, 2) decreased level of offensive odours 3) higher growth performance and improved loin eating quality, but fatter carcasses and lower pH_u in ham muscles.

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