COMPENSORY GROWTH RESPONSE IN PIGS ON PERFORMANCE, COMPOSITION OF WEIGHT GAIN AT CARCASS AND MUSCLE LEVEL AND MEAT QUALITY TRAITS

A. Heyer and B. Lebret*

Institut National de la Recherche Agronomique (INRA), UMR SENAH, 35590 Saint-Gilles, France. Email: Benedicte.Lebret@rennes.inra.fr

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Introduction

Compensatory growth in growing/finishing pigs is a well-known physiological phenomenon of accelerated final growth rate induced by a restriction - re-alimentation feeding. This feeding strategy influences the rates of lean and adipose tissue deposition at the carcass level (Campbell *et al.*, 1983), however composition of weight gain at the muscle level was hardly described in pigs. High level of intramuscular fat (**IMF**) is often reported to have beneficial effects on pork eating quality. Previous results showed that increasing age at slaughter of pigs increases the potential for IMF deposition through elevated intramuscular adipocyte number, whereas actual IMF deposition rises with energy intake (Gondret and Lebret, 2002). Thus, a feeding strategy that leads to both higher final age and daily feed intake might positively influence IMF, and therefore pork quality. Besides, it was shown that increased final growth rate might improve pork tenderness through higher muscle protein turn-over (Therkildsen *et al.*, 2002). This study aimed to increase age at slaughter of pigs by a strong feed restriction until 70 kg live weight (**LW**) followed by *ad libitum* feeding up to 110 kg LW in order to 1) increase age at slaughter of pigs and potential for IMF deposition, 2) evaluate composition of weight gain during restriction and re-alimentation and 3) increase final daily feed intake and IMF, and thereby improve pork eating quality.

Materials and Methods

At the average LW of 30 kg, 112 Duroc x (Large White x Landrace) pigs (females and castrated males) were equally allocated to either group **AL** (*ad libitum* feeding during growing (30-70 kg LW) and finishing (70-110 kg LW) with conventional growing and finishing diets), or **CG** (compensatory growth: feed restriction at 65% of AL feed intake during growing (growing diet), and *ad libitum* thereafter (finishing diet)). Pigs were kept in individual pens and slaughtered at 70 kg (n=30) or 110 kg (n=82). Fourteen pigs issued from the same litters were slaughtered at 30 kg LW for determination of carcass composition at start of the experiment. Carcass weight, average backfat thickness ($3^{rd}/4^{th}$ lumbar vertebra and $3^{rd}/4^{th}$ last rib levels), muscle depth ($3^{rd}/4^{th}$ last rib level) and lean meat content (calculated for 110 kg LW only, from linear measurements) were measured on the day of slaughter. The day after, the ham was partially dissected into muscles, subcutaneous fat, and bones. Samples of *m. longissimus* (**LD**) were taken, trimmed of external fat and freeze dried before IMF (=petroleum ether extract) and protein (=6.25*nitrogen, Dumas method) determinations. Deposition rates of lean and fat tissues and of LD components during both growing and finishing periods were calculated from tissue weights and LD chemical composition. Data were submitted to an analysis of variance (proc GLM, SAS), including the fixed effects of feeding regimen and sex and the random effect of sow within sire.

Results and Discussion

Feed restriction at 65% of the *ad libitum* level during growing phase resulted in a 35% decrease in average daily gain and a 22 d increase in age at 70 kg LW for CG compared with AL pigs (Table 1). During re-alimentation average daily feed intake (**ADFI**) of CG pigs was strongly increased (+255%) compared to their growing period, and corresponded to 108% of the ADFI of the AL pigs during finishing. This demonstrated a compensatory feed intake for the CG pigs, which had additionally a better finishing feed conversion ratio. This led to a 13% higher growth rate of these pigs during finishing. Hence, CG pigs expressed a compensatory growth, and were 19 d older at 110 LW than AL pigs. Thus, the objective of the study to produce older pigs with same market weight and higher final growth rate through a specific feeding strategy was reached.

Feed restriction reduced carcass fatness, as already reported (Gondret and Lebret, 2002). After re-alimentation, carcass fatness and lean meat content did not differ between CG and AL pigs, indicating that compensatory growth modifies the composition of weight gain with higher lipid than protein deposition at the carcass level. It was already demonstrated that a restriction-re-alimentation feeding strategy might improve pig performance and influence carcass traits. However, the effects depend on the onset, intensity and duration of the restriction, and onset and duration of the re-alimentation (Campbell *et al.*, 1983; Therkildsen *et al.*, 2002).

IMF was slightly lower for CG than AL pigs at 70 kg LW, and was still lower for CG pigs at 110 kg LW (Table 2). LD protein content was not affected by feeding regimen. Feed restriction reduced muscle (-30%) and lipid (-50%) deposition rates in both ham and LD. During re-alimentation, muscle deposition rates in ham and LD were similar in CG and AL pigs, but LD protein deposition tended to be reduced in CG pigs. Subcutaneous fat deposition was increased, but IMF deposition did not differ between CG and AL pigs during re-alimentation, explaining the similar

carcass fatness and lower IMF of the CG pigs at 110 kg LW. Thus, CG pigs did not catch up on the previous retardation of IMF deposition during a 33 d re-alimentation period, which favoured external fat deposition. Hence, an increased IMF content through CG feeding strategy could not be obtained. Meat quality traits (pH1, pHu, drip loss) were not affected by the feeding strategy (data not shown).

Conclusions

A 65% feed restriction until 70 kg LW followed by *ad libitum* feeding during finishing resulted in an expected higher age of pigs at commercial market weight compared to controls. Re-fed pigs expressed a compensatory growth during finishing, and similar carcass traits at 110 kg LW due to higher deposition rate of adipose than muscle tissues at the carcass level during re-alimentation. However, at muscle level, composition of weight gain was not modified. Consequently, the initial hypothesis of increased IMF deposition in CG pigs during re-alimentation could not be verified. Technological pork quality was not influenced by the feeding strategy. It can be hypothesized that an elevated IMF content in re-fed pigs, that would improve pork quality, might be achieved through forwarding the pattern of restriction – re-alimentation periods.

Table 1: Growth performance and carcass composition of pigs slaughtered at either 70 or 110 kg LW and allocated to different feeding regimes.

	LW70				LW110			
	AL	CG	RSD[1]	*P*-value	AL	CG	RSD	*P*-value
No. of animals	56	55			41	40		
Live weight, kg	72.0	71.3	2.10	0.074	110.9	112.8	2.21	**0.001**
Age at LW 70/110, d	118	140	5.48	**0.001**	154	173	6.70	**0.001**
Daily feed intake, kg/d	2.32	1.53	0.13	**0.001**	3.62	3.90	0.30	**0.001**
Daily weight gain, g/d	980	634	48.0	**0.001**	1113	1257	101.3	**0.001**
Feed conv. ratio, kg/kg[2]	2.37	2.41	0.13	0.131	3.27	3.10	0.19	**0.001**
No. of animals	15	15			41	40		
Hot carcass, kg	55.3	56.4	1.85	0.142	90.1	90.2	2.10	0.797
Dressing, %	78.0	78.3	1.11	0.157	81.2	80.0	1.01	**0.001**
Backfat thickness, mm	14.4	11.4	1.65	**0.039**	21.0	20.6	3.20	0.603
Muscle depth$_{\text{last rib}}$, mm	47.0	48.6	5.59	0.460	61.8	60.1	5.33	0.183
Lean meat content, %					58.9	58.8	2.08	0.867

Table 2: Chemical composition of *m. longissimus* and muscle, protein and fat deposition rates in ham and *m. longissimus* of pigs slaughtered at either 70 or 110 kg LW and allocated to different feeding regimes

	LW70				LW110			
	AL	CG	RSD	*P*-value	AL	CG	RSD	*P*-value
No. of animals	15	15			41	40		
IMF of LD, %	1.50	1.24	0.35	0.074	2.53	2.20	0.66	**0.032**
Protein of LD, %	22.4	22.1	0.45	0.115	22.8	22.6	0.53	0.094
No. of animals	13	13			13	13		
Deposition rates in ham								
Muscle, g/d	66.3	48.7	5.74	**0.001**	65.3	60.8	11.7	0.414
Subcutan. fat, g/d	11.6	6.5	2.53	**0.001**	20.9	26.6	4.64	**0.033**
Deposition rates in m. longissimus								
Muscle, g/d	24.8	17.3	2.63	**0.001**	23.9	19.9	5.43	0.100
Protein, g/d	5.8	4.0	0.61	**0.001**	5.8	4.8	1.33	0.054
IMF, g/d	0.46	0.24	0.13	**0.001**	1.09	0.92	0.48	0.547

[1]Residual standard deviation. [2]Interaction between feeding regimen and sex was found for the 70-110 kg LW period ($P<0.05$).

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