Impact of liquid feeding and health status on the use of a high level of rapeseed meal in pig fattening diets

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Abstract: Two experiments were conducted to evaluate how initial health status and liquid feeding could modify the feed intake and performances of growing-finishing pigs given diets that included rapeseed meal. A total of 288 castrate male and female pigs, previously reared in different sanitary conditions during post-weaning, were used in two experiments and allocated to one of four treatments. Animals were housed in pen groups of 6 and were given a grower diet then a finisher diet including rapeseed meal at a rate of 8 or 18 % in dry or liquid feeding. Diets were iso-energetic and contained the same levels of amino-acids. The diets were given *ad libitum* using hoppers or a computer controlled liquid feeding system. From entry to slaughtering (29 to 115 kg LW), a good overall performance was achieved in Exp.1 whereas high disease prevalence and poor growth were observed in Exp.2. For both experiments, there were no significant differences in the performance for intake, growth and lean meat rate between 8% and 18% rapeseed meal fed pigs. Pigs offered liquid feeding had better feed intake (Exp.1: +12%, P <0.001; Exp.2: +16%, P <0.001) and growth but feed efficiency and lean mean rate were degraded. With these results, it can be concluded that rapeseed meal included at a 18 % incorporation rate in pig diets has no negative effect on feed intake, growth performance and carcass quality either in dry or in liquid feeding systems.
Key words: rapeseed meal, pig, sanitary degradation, liquid feeding

INTRODUCTION

In fattening pig diets, it is well established that rapeseed meal (RSM) can be used at high incorporation levels (Schöne et al., 1997a, b; Albar et al., 2001). However, most of these studies explored only dry feeding conditions whereas liquid feeding is a widespread system in Western Europe. Furthermore, it was thought that inclusion of RSM could have a negative effect on consumption when liquid feeding is used. The taste or visibility of black particles of rapeseed in the feed may decrease the palatability and feed intake. Thus, lower incorporation limits for liquid feeding than for dry feeding were often proposed (Sommer, 2005; MLC, 2005; Guillou and Landeau, 2005). Similarly, it is often thought that the high RSM intake levels observed in the research centres cannot be applied in commercial pig farms where the health status is poorer. In the present study, our objective was to determine the effects of both liquid feeding and sanitary status on feed intake and growth performance of growing-finishing pigs fed with high levels of RSM.

MATERIALS AND METHODS

In each of two experiments, 144 pigs of both sex (barrows and gilts) and crossbred ((LWxLd)xP76) from Ifip Swine Research Station (Villefranche de Rouergue, France) were used at 70 d of age. Initial health status of animals was different between Exp.1 and 2. During the previous post-weaning period (28 to 70 d of age), 56% of pigs in Exp.1 and 11% in Exp. 2 were housed in the poor sanitary conditions already described by Le Floc'h et al. (2006) and Gaudré et al. (2007) as a model to modulate inflammatory status. Briefly, these piglets did not receive any antibiotic supplementation and were housed with moderately high density in rooms in which remained manure from the previous occupation.

In each experiment, pigs were blocked on the basis of body weight, sex and previous period and randomly affected to 1 of the 4 treatments in a 2 x 2 factorial design. Pigs received diets including either 8 (Control) or 18 % RSM (RSM18) and were fed using either dry or liquid

Table 1 – Ingredient composition and nutrient content of the diets in Exp. 1 and Exp.2 (% or g/kg as fed basis).

Diet	Exp.1 Growing Control	Exp.1 Growing RSM18	Exp.1 Finishing Control	Exp.1 Finishing RSM18	Exp.2 Growing Control	Exp.2 Growing RSM18	Exp.2 Finishing Control	Exp.2 Finishing RSM18
Ingredient (%)								
Wheat	44.8	59.1	56.5	64.4	50.4	50.7	47.6	42.6
Barley	34.7	18.0	26.0	15.0	18.0	14.0	25.3	17.7
Corn					10.0	10.0	10.0	18.0
Rapeseed meal	8.0	18.0	8.0	18.0	8.0	18.0	8.0	18.0
Soybean meal	9.7	2.3	7.3		10.1	3.2	6.0	
Oil				0.5	0.5	1.4	0.5	1.3
Amino acids*	0.48	0.55	0.43	0.50	0.54	0.60	0.51	0.54
Premix	2.33	2.11	1.77	1.66	2.48	2.14	2.09	1.90
Analysed content (g/kg)								
Dry matter	887	887	888	888	887	889	885	886
Crude protein	159	167	156	158	163	162	148	149
Crude fibre	47	47	43	49	37	45	35	43
Starch	471	472	494	477	474	453	495	481
Fat	15	15	16	21	22	34	21	33
Ash	41	43	38	40	41	41	36	36
NDF	142	148	138	150	124	138	133	138
Total lysine	9.7	9.7	8.8	9.4	10.6	10.6	8.9	9.5
Total glucosinolates**, µmol	0.9	1.7	0.8	1.8	1.1	2.5	1.1	2.5
Calculated nutrients (g/kg)								
Net energy, MJ	9.40	9.40	9.60	9.60	9.74	9.73	9.80	9.81
Digestible phosphorus	2.5	2.5	2.0	2.2	2.5	2.5	2.0	2.1
Digestible lysine	8.5	8.5	7.7	7.7	8.8	8.8	7.8	7.9

*L-lysine, DL-methionine, L-threonine ; Digestible methionine, threonine and tryptophane to digestible lysine ratios were 30, 65, 65 and 19 %, respectively. **The total GLS content is the total value of alkenyl-glucosinolates: progoitrine (PRO), epiprogoitrin (E-PRO), gluconapoléiférin (GNL), glucoalyssine (GAL), gluconapine GNA, glucobrassicanapine (GBN), and aralkyl-glucosinolates : sinalbin (SNB), gluconasturtiine (GST) et des indolyl-glucosinolates : 4-hydroxyglucobrassicine (4OH-GBS), glucobrassicine (GBS), neoglucobrassicine (N-GBS).

distribution equipment. Each treatment consisted of 3 pens of barrows and 3 pens of females with 6 animals per pen.

Feeds were prepared in the manufactory of Ifip. Grower and finisher diets were formulated to meet usual energy and amino acids requirements of 27 to 65 kg growing pigs and 65 to 110 kg finishing pigs (Table 1). The digestible lysine to net energy ratios were 0.9 and 0.8 g/MJ for growing and finishing diets, respectively. The mineral supplement supplied 0.25 mg iodine per kg. Diets were based on wheat, barley and soybean meal (plus corn for Exp.2). For 18 % RSM diets, the RSM proportion was increased in substitution of corn and soybean meal. Commercial batches of RSM were used: 2 batches containing 7.3 and 10.8 µmoles glucosinolates (GSL) per g were combined in Exp.1, 1 batch with 13.9 µmoles/g in Exp.2.

The liquid feeding facility of the Ifip centre was modified so to have, for each side of the central corridor, 12 liquid distributed pens or 12 identical pens with feeders. Liquid feed was produced with an automatic liquid feeding system by mixing water to dry meal at a dilution ratio of 2.6:1 (l/kg) from day 1 to 34 of Exp.1, then 2.8:1. In Exp.2, the dilution ratios were 2.6:1 from day 1 to 39, 2:1 from day 40 to 65, then 3.0:1 l/kg. The liquid feeds were offered twice daily according to appetite, up to a maximum of 3.2 kg/d for barrows and 2.9 kg/d for females. Dry fed pigs were given *ad libitum* access to the diets from dry meal hoppers.

Pigs were individually weighed at the beginning of the experiment then at 14 day intervals until the day of slaughtering. Feed consumption was measured for each pen. Pigs were harvested when individual pigs reached 115 kg. They were slaughtered in two batches per experiment: on d 87 and 100 in Exp.1 and d 98 and 117 in Exp.2. Samples of RSM and feeds were taken for each experiment and were analyzed for nutrient content (Table 1). GSL analyses were performed by high performance liquid chromatography (NF ISO 10633-1) in the Cetiom laboratory (Ardon, 45). The GSL breakdown products have not been measured.

Table 2 - Effect of dry or liquid feeding and RSM level on pig performance[a]

Distribution	Dry		Liquid			Effects[b]		
Diet	Control	RSM18	Control	RSM18	RMSE	L	RSM	L x RSM
Experiment 1								
Weight day 1	28.1	28.1	28.0	28.0	0.0	NS	NS	NS
Weight day 86	104.4	104.2	109.9	109.4	1.67	< 0.001	NS	NS
Daily feed intake, kg/d	2.39	2.34	2.62	2.65	0.07	< 0.001	NS	NS
Daily gain, g/d	893	895	953	954	22	< 0.001	NS	NS
Feed conversion, kg/kg	2.68	2.61	2.75	2.78	0.09	0.003	NS	NS
Carcass weight, kg	90.6	90.7	90.6	91.1	2.0	NS	NS	NS
Dressing percentage	0.78	0.78	0.77	0.77	0.00	< 0.001	NS	NS
Lean meat percentage	58.8	58.3	58.2	58.3	0.9	NS	NS	NS
Experiment 2								
Weight day 1	29.9	29.9	29.9	29.9	0.0	NS	NS	NS
Weight day 97	105.1	106.4	110.7	110.4	4.0	0.009	NS	NS
Daily feed intake, kg/d	2.15	2.15	2.51	2.46	0.09	< 0.001	NS	NS
Daily gain, g/d	782	786	823	828	45	0.037	NS	NS
Feed conversion, kg/kg	2.74	2.74	3.06	2.97	0.12	< 0.001	NS	NS
Carcass weight, kg	92.3	93.3	92.9	94.0	2.3	NS	NS	NS
Dressing percentage	0.78	0.78	0.78	0.78	0.01	NS	NS	NS
Lean meat percentage	59.6	58.6	57.9	58.1	1.0	0.015	NS	NS

a) Values in the table are presented as least-square means and root mean square error (RMSE) for six pens of 6 pigs each.
b) P value from analysis of variance including the effects of block, distribution equipment (L), diet (RSM), and LxW interaction. Sex was added as effect for carcass data. NS: not significant, P > .05.

Data analyses were performed using the GLM procedure (SAS Institute, Cary, NC) with pen as experimental unit. The model included the effects of diet, distribution equipment, block and the interaction effect of diet and equipment. For carcass measurements, sex was added to the model. Tukey test was used for means separation.

RESULTS

Most of the pigs of Exp.1 were reared under poor conditions during post-weaning but had a homogeneous health status which resulted in good fattening performance. Conversely, the mixing of animals with heterogeneous health status degraded fattening performance in Exp.2. Thus, the number of pigs that died or were removed from the experiment was 1.4% in Exp.1, and reached 7.6% in Exp.2. Additionally, 6% and 18% of pigs in Exp.1 and 2, respectively, were individually treated (respiratory, nervous, digestive and musculoskeletal symptoms, stunting) without any difference among diets or equipments. As a result, animal performance was higher in Exp.1 (mean daily feed intake from 28 to 114 kg was 2500 g/d and average daily gain for the same period was 924 g/d) than in Exp.2 (from 30 and 116 kg, 2317 and 804 g/d, respectively) (Table 2).

Pigs given liquid feed had higher intake than pigs offered dry meal in Exp.1 (+12%, P <0.001) and Exp.2 (+16%, P <0.001). As a consequence, the liquid feeding resulted in higher daily gain in Exp.1 (+7%; P <0.001) and Exp.2 (+5%; P = 0.037). Weight at first harvest was increased by liquid feed in Exp.1 (+5.4 kg; P <0.001) and Exp.2 (+4.8 kg; P = 0.009). However, liquid distribution degraded feed conversion ratio in Exp.1 (+5%; P = 0.003) as well as in Exp.2 (+10%; P <0.001). For both experiments, the RSM incorporation rate did not significantly influence the feed intake. As a consequence, daily growth, live weight and feed conversion were unaffected by the amount of RSM in experimental diets. Furthermore, the interactions between RSM and feeding equipment were not significant.

Respectively, 142 and 133 pigs of Exp.1 and 2 were slaughtered at 113.7 and 116.5 kg live weight. In Exp.1, dressing percentage was less important for pigs that received liquid feed than for other pigs (77 vs. 78 %; P <0.001). In Exp.2, lean mean percentage was decreased by liquid feeding (58.0 vs. 59.1; P = 0.015). Differences in mean values for carcass characteristics were not influenced by RSM percentage neither in Exp.1 nor in Exp.2.

DISCUSSION AND IMPLICATIONS

A poor initial health status may cause a variable performance during the fattening period. It has already been reported that similar sanitary degradations during post-weaning improved or degraded growing-finishing performance (Gaudré, 2011). In spite of differences of disease prevalence and global performance between Exp.1 and 2 of the present study, the same effects of liquid feeding and RSM inclusion were observed. Liquid feeds were mainly distributed *ad libitum* in our study. In agreement with our earlier observations (Royer, not published), this resulted in higher intake and daily gain than for dry meal, but also in deterioration of feed efficiency and muscle percentage. However, liquid feeding is a complex system that needs good management and reliability.

Our results support research showing no adverse effect of the inclusion of RSM at 10% in grower diet and 15% in finisher diet, in liquid or wet feeding (Weber et al., 2007; Weiss, 2008). This study is also consistent with our previous work, which compared liquid feed based on soybean meal and liquid feed containing 15 then 18% RSM during growing and finishing periods, respectively (Royer et al., 2005). Total GSL contents in 18 % RSM diets were relatively high (1.7 and 2.5 µmol/g in Exp. 1 and 2, respectively) and slightly exceed the maximal value of 2 µmol/g diet proposed by Schöne et al. (1997a) for pig feeding. Moreover, the total daily intake of GSL by liquid fed pigs in Exp.2 (6.25 mmol/d) went moderately above the limit of 5 mmoles per day proposed for gestating sows by Etienne et al. (1993), but without modifying growth response.

It should be noted that fattening pigs are not more sensitive to the supposed low palatability factors of RSM when given a liquid feed or previously housed in an environment of low sanitary quality. As a consequence, it seems not necessary to restrict the use of RSM in liquid feeding. It appears that including 18% RSM in feed has no effect on growth performance and carcass characteristics.

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