The effect on growing pig performance of changes in energy intake achieved through restriction of feed intake versus changes in dietary energy concentration

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"The utilization of net energy for body weight gain was unaffected by feeding level or by energy concentration of the diet"

SUMMARY
This study demonstrates that the energy intake of pigs can be successfully manipulated by progressive restriction of feed allowance; while changes in dietary energy may not result in changes in the pigs' energy intake. Accordingly, restriction of feed allowance was accompanied by significant changes in the performance parameters studied (ADG, ADFI, G:F, PDR); while only ADFI was significantly affected by changes in dietary energy concentration.

INTRODUCTION
The pig's energy intake can be manipulated through restriction of its feed intake or by altering the energy density of its diet. The former approach is commonly taken in a research setting while the latter is generally the more common approach in commercial pork production. Restriction of the growing pig's feed intake results in decreases in energy intake and in average daily gain. Some authors report analogous findings when dietary energy concentration is manipulated while others report that changing dietary energy concentration does not affect energy intake or growth performance. The objective of the present experiment was to compare the pig's response to changes in energy intake brought about by either a change in feed intake or altering dietary energy concentration.

MATERIALS AND METHODS
Dietary treatments were arranged in a 3 x 3 factorial design with 3 feeding levels (80, 90 and 100% of ad libitum) and 3 dietary net energy concentrations (2.18, 2.29 and 2.40 Mcal/kg). Net energy concentrations were adjusted through proportional changes in the inclusion levels of wheat (15.00, 39.55 and 64.51 % as-fed), barley (55.45, 31.33 and 6.80 % as-fed) and canola oil (1.00, 2.25 and 3.50 % as-fed) in the experimental diets.

Seventy-two individually-housed barrows (initial bodyweight 30 ± 2 kg) each received one of nine dietary treatments. On a weekly basis, the pigs were weighed, the feed allowances of the restricted-fed pigs were adjusted and the feed intake (disappearance) of the ad libitum-fed pigs recorded. Pigs were removed from the experiment at a bodyweight of 60 ± 2 kg.

Data analysis was performed using the MIXED procedure of SAS (SAS Institute, 1996) to examine the fixed effects of feeding level, energy concentration and their interaction.

RESULTS AND DISCUSSION
No interactive effects between feeding level and dietary energy concentration were found ($P > 0.10$). Average daily gain (ADG), average daily feed intake (ADFI), gain:feed (G:F) and protein deposition rate (PDR) increased with increasing feeding level (Table 1; $P < 0.05$). Increasing diet net energy concentration reduced ADFI ($P < 0.05$) but had no effect on ADG, G:F or PDR ($P>0.10$).

As feeding level increased, daily NE intake increased and a greater quantity of NE was available to the pig for bodyweight gain ($P < 0.001$); however, the efficiency with which

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this portion of dietary NE was utilized for growth was unaffected by dietary treatment (Table 1; P > 0.10). Diet NE concentration has no effect on NE intake or NE available for body-weight gain (P > 0.10). The utilization of NE for gain was unaffected by feeding level or by energy concentration (P > 0.10).

The response of growing pigs to changes in dietary energy concentration differed from their response to changes in feed allowance. Each of the two approaches to studying the pig's response to dietary energy provides very useful information on energy metabolism, but extrapolating the findings of one to circumstances of the other must be done with great care. This is particularly noteworthy since most pigs in commercial production are fed ad libitum.

IMPLICATIONS

The present study indicates that, in terms of swine energy metabolism, it may not be universally appropriate to apply knowledge obtained using restriction of feed intake to scenarios in which dietary energy concentration is to be manipulated, and vice versa.

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Table 1. Effects of feeding level and energy concentration on the performance of growing pigs

	Feeding level, % ad lib			NE Concentration, Mcal/kg			
Item	80	90	100	2.18	2.29	2.40	SEM
N	24	23	23	24	23	23	-
Initial BW, kg	30.4	30.4	29.6	30.2	30.2	30.0	0.34
Final BW, kg	59.6	60.3	60.2	60.3	59.7	60.0	0.45
ADG, kg[1]	0.72	0.85	1.06	0.89	0.85	0.88	0.02
ADFI, kg [1, 2]	1.61	1.87	2.05	1.93	1.81	1.78	0.04
G:F, kg/kg[1]	0.45	0.46	0.52	0.46	0.47	0.50	0.02
PDR, g/d[1]	135	153	172	147	156	158	5.5
NE_{Intake}, Mcal/d[1]	3.69	4.26	4.68	4.20	4.14	4.27	0.10
$NE_{Maint.}$, Mcal/d[3]	1.36	1.37	1.36	1.37	1.36	1.36	0.01
NE_{Gain}, Mcal/d[1,4]	2.33	2.92	3.32	2.83	2.78	2.91	0.07
$NE_{Efficiency}$, Mcal/d[5]	3.30	3.43	3.19	3.24	3.31	3.36	0.12

PDR: Carcass protein deposition rate,
[1] Main effect of feeding level (P<0.001),
[2] Main effect of NE Concentration (P<0.001),
[3] $NE_{Maint} = 0.75*106*BW^{0.75}$ (NRC, 1998; Noblet, 2007),
[4] $NE_{gain} = NE_{Maint}$ [5]NE_{gain}/ADG