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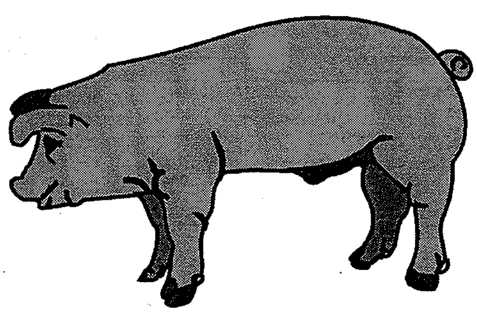

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Dietary Energy Concentration Effects Carcass Leanness in Finishing Hogs.

Background.
During the finishing phase of the growing period, the pig's ability to consume feed usually exceeds its capacity for protein deposition (Whittemore, 1987). Consequently, a relatively large portion of the energy ingested during this period is deposited as carcass fat, thus lowering the protein to fat ratio in the carcass. In numerous experiments, restricting feed intake during the finishing phase has been shown to have a favorable influence on carcass leanness (Veum et al., 1970, Kanis, 1988, Williams et al.,1994). The reason for this is that a moderate decrease in daily energy intake leads to a decrease in daily fat deposition, whereas protein deposition can be maintained at the maximum level (Campbel et al. 1985). However, restricting feed intake is not possible on many commercial swine operations, because the equipment is usually designed for ad libitum feeding. Hence, it is necessary to examine other possibilities for decreasing daily energy intake under these circumstances.

The effects of dietary energy concentration on total energy intake has been examined in a few experiments. Working with growing pigs from 20 to 45 kg, Campbell and Taverner (1986) showed that voluntary food intake as measured in kg per pig per day was not influenced by the energy concentration of the diets. Hence, pigs receiving diets with a low energy concentration consumed less energy per day than did pigs fed a diet with a high energy concentration. Consequently, less fat was deposited in the carcass of pigs fed low energy diets. A similar conclusion was reached by Cook et al., (1991). Contrary to this, in experiments with finishing pigs, it has been indicated that pigs heavier than approximately 50 kg live weight compensate for being fed a low energy diet by increasing daily feed intake (Cole at al., 1967, Kennelly and Aherne, 1980). These findings have led to the conclusion that "pigs eat to meet their energy requirement". If this is true, it would seem impossible to decrease daily energy intake, and thus, decrease daily fat deposition, by feeding low energy diets to finishing pigs. However, in European experiments conducted with very lean genotypes, a constant daily feed intake in kg per day has been reported regardless of dietary energy concentration (Just, 1984, Håkonsson and Lundeheim, 1993). In these experiments, daily energy intake has been decreased by feeding diets with a low energy concentration, and the protein to fat ratio in the carcass has been enhanced.

Due to the increased importance of being able to market lean hogs, we found it of interest to investigate the effect of dietary energy concentration on carcass leanness in a modern genotype.

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Objective.

The objective of the present experiment was to examine the hypothesis that carcass leanness in ad libitum fed finishing pigs is negatively correlated with the dietary energy concentration if diets are diluted with fibers and fed to pigs during the finishing period.

Materials and methods.

One hundred and fifty barrows arising from the matings of Camborough 15 females to PIC Line 326 boars (Pig Improvement Company, Franklin, Kentucky) were allotted to one of five treatment groups at an approximately weight of 54 kg in a randomized complete block design with six replicates per treatment group. Each replicate contained 25 pigs and there were five pigs per pen. Each pen was considered an experimental unit. Five different energy levels were examined against each other in the design shown in table 1.

Table 1. *Experimental design.*

Group #	1	2	3	4	5
Kcal/kg	3,500	3,300	3,100	2,900	2,700

Pigs were housed in the finishing building at the Swine Research Center, University of Illinois. The facilities there are similar to typical commercial production units. The pens have partially slatted concrete floors and solid side walls. Feed was provided on an ad lib. basis from a two space standard feeder. Water was provided ad lib. from a biting nipple suspended on the pen sidewall. The barn is mechanically ventilated by a negative pressure ventilation system with mechanical fans. The temperature was held at approximately 20 degrees Celsius throughout the experiment. When an approximately weight of 112 kg were reached, pigs were slaughtered at the University of Illinois abattoir, and carcass measurements were obtained. Pigs were fed the same diet during the entire experimental period as shown in table 2.

Table 2. *Composition of the experimental diets.*

Diet #	1	2	3	4	5
Ingredients, %					
Corn	67.85	75.9	62.5	49.4	36.15
Soybean meal	24.4	22.0	17.5	12.9	8.4
Fat	5.5	-	-	-	-
Wheat Bran	-	-	10.0	20.0	30.0
Corn Gluten Feed	-	-	5.0	10.0	15.0
Alfalfa Meal	-	-	3.0	6.0	9.0
Vit. + Min.	2.25	2.1	2.0	1.70	1.45

Diet 2 was a traditional corn-soybean meal diet, - this diet served as the control diet. Diet 1 was a corn-soybean meal diet with added fat, consequently, this diet had a higher energy level than the control diet. In diet 3, the energy concentration was reduced to 3,100 kcal/kg by the addition of wheat bran, corn gluten feed and alfalfa meal. In diet 4 and diet 5, the energy concentration was further reduced by the addition of higher levels of wheat bran, alfalfa meal and corn gluten feed. The lysine level in diet 5 was 0.67 %, which is 10 % above the NRC requirement for finishing pigs (NRC, 1988). The level of lysine in the other diets were adjusted in accordance with the energy level, thus, the same lysine to energy ratio was maintained in all diets. All other indispensable amino acids were supplied at a level that meets or exceeds the needs calculated using "The Illinois Ideal Protein". (Baker and Chung,1992). The reason for adding lysine at a higher level than the NRC recommendation was to make sure that the pigs potential for lean growth was not restricted by the level of lysine or other amino acids. The levels of all other nutrients were provided according to NRC recommendations (NRC, 1988).

Results.
The results from the experiment are shown in table 3.

Table 3. *Results from the growth experiment.* *

Diet #	1	2	3	4	5
Initial weight, kg.	53.9	54.7	54.4	53.6	54.1
Final weight, Kg.	113.8	113.9	111.8	112.9	111.2
Average daily gain, g.	1017^{a}	1038^{a}	1006^{ab}	931^{bc}	872^{c}
Feed intake, kg/day	2.91^{a}	3.28^{b}	3.36^{b}	3.23^{b}	3.31^{b}
Feed intake, mcal/day	10.17^{ab}	10.83^{a}	10.41^{a}	9.36^{bc}	8.93^{c}
Gain:feed, kg/kg	0.35^{a}	0.32^{b}	0.30^{bc}	0.29^{c}	0.26^{d}
Gain:feed, g/Mcal	100	96	97	100	98
Dressing, %	75.97^{a}	74.9^{ab}	74.56^{bc}	73.96^{c}	73.51^{c}
10th Rib fat, inc.	0.85^{a}	0.86^{a}	0.78^{ab}	0.70^{b}	0.69^{b}
Loin Eye Area, Inc^2	5.71	5.57	5.68	5.62	5.34
Carcass lean, %	50.78^{ab}	50.42^{b}	51.72^{ab}	52.32^{a}	52.0^{ab}
Avg. daily lean gain, g.	392^{a}	382^{ab}	386^{ab}	358^{bc}	330^{c}

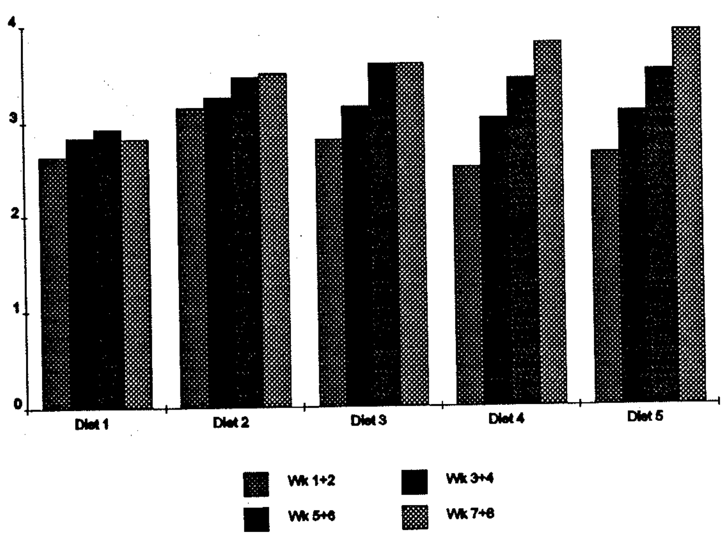
*Values with different superscripts are significantly different ($P< 0.05$)

The daily weight gain of pigs on treatment diets 4 and 5 was significantly lower than that obtained by pigs on treatment diets 1 and 2 ($P < 0.05$). In addition, pigs on treatment diet 3 also gained weight significantly faster than pigs on treatment diet 5 ($P < 0.05$). The daily feed intake in kg per pig per day was not significantly different between pigs on treatment diets 2,3, 4, and 5, but pigs on diet 1, consumed significantly less feed than did pigs on the other treatment diets ($P<0.05$). However, due to the differences in energy concentration in the diets (table 1), pigs fed diets 4 and 5 consumed significantly less calories per day than did pigs fed diets 2 and 3, and pigs on diet 5 also had a lower energy intake than had pigs on diet 1 ($P<0.05$). The gain:feed ration measured in kg decreased linearly with decreasing energy level in the diets, but if measured as gain per energy unit, no significant differences between treatment groups were observed.

Pigs on all treatment groups were killed at the same weight ($P> 0.2$), but the dressing percentage decreased significantly with decreasing energy level in the diets ($P<0.05$). Likewise, the back fat thickness tended to decrease with decreasing energy levels in the diets, and pigs on treatment diets 4 and 5 had significantly less back fat than had pigs fed treatment diets 1 and 2. The area of the loins did not differ significantly between treatment groups, although pigs fed treatment diet 5 tended to have smaller loin eye areas than pigs fed treatment diet 1 ($P = 0.099$). Pigs fed the control diet had a significantly lower lean percentage in the carcass compared to pigs fed diet 4. Pigs fed diet 1 tended to have a lower lean percentage than pigs fed diet 4 ($P = 0.074$), and pigs fed diet 5 tended to have a higher lean percentage than pigs fed diet 2 ($P= 0.075$). Pigs fed diet 1 had a significantly higher average daily lean gain than had pigs fed diets 4 ($P< 0.05$), and pigs fed diets 1, 2, and 3 had a significantly higher daily lean gain than had pigs fed diet 5 ($P<0.05$).

Since pigs were weighed biweekly, it was possible to calculate the feed intake over each two week period. This is shown in figure 1.

Figure 1. Average daily feed intake for each diet during each 2 week period.



It appears that pigs on diet 1 had a constant feed intake throughout the experiment, whereas pigs on the high fiber diets had a lower feed intake during the initially two weeks of the experiment, and then gradually increased daily feed intake throughout the experimental period.

Discussion and conclusions.

Pigs on dietary treatments 2, 3, 4, and 5 had a similar feed intake in kg per pig per day (table 3), consequently, daily energy intake decreased with dietary energy concentration. This explains the decrease in daily growth rate observed on diets 3, 4, and 5, as compared to diet 2. S imilar observations were previously reported by Powley et al. (1981) and Chromwell et al. (1992). As expected, the decrease in daily energy intake observed in pigs fed the high fiber diets led to a decrease in daily fat deposition, and accordingly, pigs fed the low energy diets had a higher percentage of lean in the carcasses when slaughtered. Although the daily growth rate decreased with decreasing energy content in the diets, it is interesting to note that only a moderate decrease in daily lean growth rate was observed in pigs fed diets 4 and 5 as compared to pigs fed diets 1 and 2. These findings are in agreement with the reports from Just (1984) and Håkonson and Lundeheim (1993). In these two experiments, also very lean genotypes were used, thus, it may well be that modern lean genotypes are not able to compensate for a low energy concentration in the diet by increasing feed intake. However, the data in figure 1 indicate that pigs low energy and high fiber diets tends to compensate over time, and that the effect is larger during the initial weeks after the introduction of the low energy diets. This observation is in agreement with the results obtained by Kennelly and Aherne (1980), who reported, that feed intake was decreased in pigs fed low energy diets only during the growing phase, but not during the finishing phase. In our experiment, we fed pigs the low energy diets for the final 8 weeks of the finishing period, however it is possible that better results could be obtained by feeding the low energy diets for only 4 or 6 weeks. The decrease in feed intake in pigs fed diet 1 as compared to pigs fed diets 2 seems to indicate that by adding fat to a diet, a different mechanism of regulation is activated, and pigs fed the fat-containing diet did not increase their daily energy intake. This finding is in agreement with Campbell and Taverner (1986) and with Walker (1986). From these two experiments, it was also concluded that pigs do not increase daily energy intake if fat is added to the diet. The reason for this may be that passage rate of digesta is decreased when fat is added to the diet. The decrease in dressing percentage observed in pigs fed low energy diets is in agreement with Powley et al. (1981), and can be explained by an increased weight of the GI-Tract due to the higher fiber concentration in the low energy diets (Kass et al, 1980).

In conclusion, the results from this experiment indicate that it is possible to decrease daily energy intake in ad libitum fed pig. By doing so, daily fat deposition will be decreased and the lean percentage in the carcass will be increased. It should be noted that this can be achived with only a moderate decrease in daily lean gain. Hence, feeding low energy diets during the finishing period seem to be a practical way of increasing lean content in market hogs. The length of the period in which low energy diets should be fed still needs to be defined.

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