EFFECT OF FEEDING HIGH OR LOW FAT MANUFACTURED LIQUID DIETS TO PIGS WEANED FROM THE SOW AT 10 DAYS OF AGE

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Summary
Previous research suggests the young pig may not respond to the energy density of manufactured liquid diets. Our objective was to determine the effect of a high (25%, HF) or low (2%, LF) fat liquid diet in pigs weaned from the sow at 10 d of age. Two replicates of 60 pigs, with an initial body weight of 4210 ± 95 g, were used in a randomized complete block design. Pigs offered LF diet consumed more feed than HF pigs (P<0.01). However, estimated metabolizable energy intake did not differ (P>0.20). Average daily gain was 336 ± 9 g/d resulting in an ending weight of 7228 ± 120 g, regardless of dietary treatment (P>0.15). Feed conversion (G/F) was 23% greater for HF pigs, compared to LF pigs (P<0.01). These results suggest that young pigs respond to a low fat diet with increased feed intake, without compromising growth performance. However, because of the lower feed conversion in pigs consuming LF diet, economic advantages will depend on the availability and costs of dietary ingredients.

Introduction
Improvements through selection, management practices, and nutrition have resulted in dramatic increases in postweaning growth performance, but growth rates have not been improved during the nursing phase of production. Increased weaning weight reduces postweaning mortality, postweaning growth lag, improves nursery performance and ultimately decreases the age at market weight (Harrell et al., 1993; Kim et al., 2001). Supplemental feeding strategies of nursing pigs provide evidence that the lactating sow does not optimize baby pig growth (Boyd et al., 1995; Azain et al., 1996). In addition, results from artificial rearing studies have also indicated that the sow does not supply adequate amounts of nutrients for optimal growth of neonatal pigs. Twenty-one day weights of over 9.5 kg are observed feeding manufactured liquid diets (Harrell et al., 1993; Oliver et al., 2000). Also, sow’s milk composition comprises approximately 50% of the total calories from fat, which suggests that the young pig requires a high amount of dietary fat in order to maximize their weight gains. This experiment was conducted to determine if a large proportion of dietary energy from lipid vs carbohydrate affects baby pig growth performance and we hypothesized that the young pig will respond to the source of dietary energy.

Materials and Methods
Two replicates of 60 pigs (n=120; 60 males, 60 females) were weaned from the sow at 10 days of age and utilized in a randomized complete block design. Pigs were blocked by weight and gender, then assigned to 1 of 6 pens (10 pigs/pen). Each block was randomly assigned to either a high (25%, HF) or low (2%, LF) fat diet. Diets were formulated such that the supply of amino acids per unit of energy was constant (Table 1), and pigs were allowed to consume diet ad libitum for 9 days. Pigs were housed in a specialized nursery building with raised pens. with
half of each pen containing a enclosed hover maintained at approximately 32°C, as described by Heo et al. (1999). Ambient temperature was maintained at approximately 24°C. Manufactured liquid diet was delivered via a gravity flow feeding system similar to Oliver et al. (2001), with the exception of 30 L Nalgene Carboys (Fisher Scientific, Pittsburgh, PA) being utilized to accommodate a pen of 10 pigs. Fresh manufactured liquid diet was added twice daily (0800 and 2000) to minimize spoilage and to ensure pigs had ad libitum access to the diet. All components of the feeding system was cleaned thoroughly prior to the first feeding (0800) with a liquid chlorinated detergent (DS Liquid: Command, Diversey Corp., Wyandotte MI). Liquid diet was prepared on a daily basis and stored at 4°C. Feed disappearance and growth were measured gravimetrically on a daily basis.

**Table 1. Composition and calculated analysis of the dietary treatments**

<table>
<thead>
<tr>
<th>Item</th>
<th>High Fat</th>
<th>Low Fat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-fat dry milk</td>
<td>45.85</td>
<td>41.92</td>
</tr>
</tbody>
</table>
International Ingredient Co. (St. Louis, MO, 63116)
Vitamin premix (Milk Specialties Corp., Dundee, IL 60118) contained
33,000,000 IU/kg Vit. A, 6,600,000 IU/kg Vit. D₃, 55,000 IU/kg
Vit. E, 257,400 ppm Vit. C, 29.983 ppm D-Pantothenic Acid,
33,069 ppm Niacin, 8378 mg/kg Riboflavin, 5,115 mg/kg
Menadione, 66 ppm Biotin, 44,000 ppm Vit. B₁₂, 2,038 ppm
Thiamine, 3,996 ppm Vit. B₆, 2,756 ppm Folic Acid
Mineral premix (Milk Specialties Corp., Dundee, IL 60118) contained
1.002% Ca, 0.549% P, 0.284% Na, 0.040% Cl, 2.024% K,
0.102% Mg, 20,000 ppm Fe, 200 ppm Co, 1,850 ppm Cu, 400
ppm I, 5,000 ppm Mn, 60 ppm Se, 23,500 ppm Zn
Calculated analysis based on analysis provided by companies furnishing
product and standard feed tables (NRC 1998)

Results
Pigs gained 336 ± 9 g/d, which resulted in an ending body weight of 7228 ± 120 g (Table 2),
regardless of dietary treatment (P > 0.15). Pigs fed HF diet consumed approximately 2376 ± 67
g dry feed/pen/d throughout the 9-day experiment (Figure 1). Pigs consuming the LF diet had
approximately 17% greater (2777 ± 67 g/d) ADFI, compared to pigs consuming the HF diet (P <
0.01). Treatment differences in ADFI were not observed on d 5 or 6 of treatment (P > 0.25).
Estimated metabolizable energy (ME) intake did not differ (Figure 2, P > 0.20), except on d 5
and 6 of treatment. As a result of the changes in feed intake and no changes in growth
performance, feed conversion (gain:feed) was increased by 23% in HF compared to LF pigs
(Table 2, P<0.01).

Table 2. Performance of young pigs fed a high (25%) or low (2%) fat manufactured liquid
diet from d 10 to 19 of age.a

<table>
<thead>
<tr>
<th>Item</th>
<th>Diet</th>
<th></th>
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</thead>
<tbody>
<tr>
<td></td>
<td>High Fat</td>
<td>Low Fat</td>
<td></td>
</tr>
<tr>
<td>Live Weight, g</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>d 10</td>
<td>4210 ± 95</td>
<td>4212 ± 96</td>
<td></td>
</tr>
<tr>
<td>d 15</td>
<td>5656 ± 110</td>
<td>5669 ± 111</td>
<td></td>
</tr>
<tr>
<td>d 19</td>
<td>7270 ± 119</td>
<td>7185 ± 122</td>
<td></td>
</tr>
<tr>
<td>ADG, g/d</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>d 10 to 15</td>
<td>289 ± 10</td>
<td>291 ± 10</td>
<td></td>
</tr>
<tr>
<td>d 15 to 19</td>
<td>403 ± 11</td>
<td>380 ± 11</td>
<td></td>
</tr>
<tr>
<td>d 10 to 19</td>
<td>340 ± 9</td>
<td>332 ± 9</td>
<td></td>
</tr>
<tr>
<td>Gain/Feed</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>d 10 to 15</td>
<td>1.53 ± 0.02 a</td>
<td>1.29 ± 0.02 b</td>
<td></td>
</tr>
<tr>
<td>d 15 to 19</td>
<td>1.36 ± 0.03 a</td>
<td>1.08 ± 0.03 b</td>
<td></td>
</tr>
<tr>
<td>d 10 to 19</td>
<td>1.44 ±0.02 a</td>
<td>1.16 ± 0.02 b</td>
<td></td>
</tr>
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</table>

Values are means ± SEM; n =60 for live weight and ADG; 
n = 6 for Gain/Feed. Within a row, means lacking a
common superscript letter differ (P < 0.05).
Figure 1. Average daily feed intake of pigs fed a high (25%) or low (2%) fat manufactured liquid diet from d 10 to 19 of age. Values shown are means ± SEM: n = 6. *Diet effect (P < 0.10). **Diet effect (P < 0.05).
Figure 2. Daily estimated metabolizable energy intake of pigs fed a high (25%) or low (2%) fat manufactured liquid diet from d 10 to 19 of age. Values shown are means ± SEM: n = 6. **Diet effect (P < 0.05).

Discussion
The most convincing data that preweaning pig growth is not maximized are results from artificial rearing studies (Harrell et al., 1993; Oliver et al., 2000). Harrell et al. (1993) found that artificially reared pigs were 53% heavier at 21 days of age compared to pigs reared on the sow (9.8 vs. 6.4 ± .5 kg) and the increased preweaning growth resulted in 10 fewer days to reach 110 kg body weight. Similar 21-day weights were found by Oliver et al. (2000) who examined corn syrup solids as a replacement for lactose in manufactured liquid diets in pigs from 2 to 21 days of age. However, in both of the above studies diets were formulated to provide excess nutrient content and the cost of ingredients was not considered in diet formulation. Extensive research has been conducted to optimize the supply of nutrients to maximize lean tissue gain during the grow-finish phases of growth, but little has been done in the nursing phases through either changes in sow milk composition or manufactured liquid diets. Sow’s milk composition comprises approximately 50% of the total calories from fat, which suggests that the young pig (i.e. < 18 day of age) requires a high amount of dietary fat in order to maximize their weight gains. Current data suggest that formulating manufactured liquid diets similar to sow’s milk composition may not be the optimum approach, neither nutritionally nor economically. For example, growth performance of pigs was maximized when the supply of lysine per unit of energy was approximately 50% higher than found in sow’s milk (Auldist et al., 1997). Furthermore, diets that were utilized in our artificial rearing studies supplied approximately 50% greater amino acid content per unit of energy than sow’s milk and resulted in heavier pig weight gains (Harrell et al., 1993; Oliver et al., 2000). Also, the dietary inclusion of conjugated linoleic acid reduced sow milk fat content by approximately 35%, but growth performance of the nursing litters was not altered (Harrell et al., 2000). These data suggest that utilizing the pattern of nutrients and energy found in sow’s milk limits preweaning pig growth.

In growing pigs, increases in dietary energy concentration result in decreased feed intake, while metabolizable energy intake remains relatively constant (NRC, 1987). However, Le Devidich et al. (1997) did not observe a response to colostral energy concentration in 1-d old pigs. While pigs were not allowed ad libitum consumption of diet, these results may still be accurate due to the limited gastric capacity of pigs at 1-d of age. In the current experiment, 10-d old pigs that received the LF diet ad libitum consumed 17% more feed, compared to HF fed pigs (P < 0.01). These data agree with Tikofsky et al. (2001), who observed an 18% increase in feed intake in bull calves fed a low fat (14.8%) compared to a high fat (30.6%) milk replacer beginning at 2 to 6 d of age. In addition Tikofsky et al. (2001) observed no difference in ME intake between a low, medium, or high fat diet, again similar to our observations.

Implications
The results from this experiment clearly show that the young pig (10 d of age) responds to the energy density of the diet. Pigs that received LF compared to HF diets had increased feed intake while ME intake remained similar between dietary treatments. Furthermore, no differences were observed in growth between pigs that consumed LF or HF diets. These data suggest that opportunities exist to alter the dietary concentration of fat in early-weaned pigs to accommodate the availability and economics of dietary ingredients.
References

1 Merrick’s Inc., Union Center, WI 53962