

## EFFECTS OF A LIQUID (NEOLAC<sup>1</sup>) AND DRY FEED COMBINATION FED IN VARYING DURATIONS ON WEANLING PIG PERFORMANCE

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### Summary

One hundred eighty pigs (initially 11.4 lb and 18 days of age) were used in a 28-d growth assay to determine the effects on nursery pig performance of combining a complete liquid feed (Neolac) with dry feed for various durations. Pigs were randomly allotted to experimental treatments consisting of: dry feed only (control) or Neolac provided for a period of 3 and 7 days in combination with dry feed. Overall, pigs fed the liquid-dry feed combination had a greater ADG ( $P < 0.01$ ) than did the dry-fed pigs until d 7 after weaning. Weight gains obtained during this period were not maintained until the end of the nursery period, regardless of the duration of liquid feeding. Both dry matter intake (DMI) and DM feed/gain increased ( $P < 0.01$ ) as a result of liquid feeding. Pigs provided liquid feed for 7 d also had a higher DM feed/gain ( $P < 0.06$ ) than that of the dry-fed controls in all periods. Feeding a liquid complete diet for various durations, in combination with dry feed, only had positive effects on growth rate immediately after weaning, but did not have lasting gains to influence overall nursery performance. Further experiments are needed to determine whether the improvement in initial feed intake with liquid feeding will reduce “starve-outs” and mortality.

(Key Words: Nursery Pig, Liquid Feed, Growth.)

### Introduction

Liquid feeding has been explored in managing nutritional challenges that typically occur after weaning. A recent review of liquid feeding by Danish researchers found that ADG of newly weaned piglets was increased by  $12.3 \pm 9.4\%$  by liquid feeding, compared with dry feeding, but a reduction in feed efficiency was normally observed in weaned pigs fed liquid diets, regardless of the type of liquid feed. The improvement in growth rate with liquid feeding is attributed mainly to an increase in ADFI. This positive ADFI response to liquid diets has a greater value immediately after weaning, which may potentially reduce “starve-outs” and improve survivability in the nursery. But most of the studies done on liquid feeding in newly weaned pigs were performed in direct replacement of dry feeding. Limited work has been done in combining the two diet forms. Therefore, this trial was conducted to determine the effects on post-weaning performance of combining dry feeding with a complete liquid diet (Neolac) for various durations.

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<sup>1</sup>Neolac is a registered trademark of Inversiones Mira S.A., Peru.

<sup>2</sup>Food Animal Health and Management Center, College of Veterinary Medicine.

<sup>3</sup>TechMix Inc., 740 Bowman St., Stewart, MN 55385.

## Procedures

A total of 180 weanling pigs (PIC L337 × C22), with an average initial weight of 11.4 lb and 18 days old, were used in a 28-d growth assay. Pigs were blocked by initial weight and were randomly allotted to 1 of 4 experimental treatments. Each treatment had 5 pigs per pen and 9 replications (pens). Experimental treatments were: dry feed only (control), or Neolac provided for a period of 3, 7, or 10 days in combination with dry feed. Liquid feeding was discontinued at d 7 of the trial because there were no more differences in body weight between treatments and because skin lesions were developing in liquid-fed pigs. Data for pigs from the 10-d Neolac treatment were added to the 7-d treatment as additional replications.

Liquid feed was provided by using translucent, 9-liter capacity, milk-replacement feeders (Kane Milk Feeders, Kane Mfg. Co. Inc., Des Moines, IA). Liquid feeders in each pen were weighed before the experiment and were positioned next to the waterer. Proper height of the liquid feeder was maintained, with the bottom of the feeder set on or close to the pen floor. Petroleum jelly was applied to the feeder cap gasket to help assure vacuum functioning in the feeder and to facilitate good flow of the liquid product. For the first 24 h, Neolac was mixed with water at a rate of 2 parts water to 1 part Neolac. After this initial mixture was consumed, all Neolac treatments were switched to full-strength Neolac, and provision of transition feed was initiated simultaneously. Neolac was added as necessary to provide *ad libitum* access. At the end of each allotted period for the liquid-dry feed combination, liquid feeders were removed, and pigs were fed only dry feed until the end of the study. Neolac treatments received a budget of 5 lb/pig of transition diet and a Phase 2 diet for the remainder of the experiment. For the control treatment, pigs were fed 1 lb/pig of pelleted SEW diet at the start of the experiment. After this was consumed, pigs

received the same budget for transition and Phase 2 diets as the pigs in Neolac treatments. All diets were formulated according to K-State standard specifications (Table 1).

The trial was conducted in the environmentally controlled /Segregated Early Weaning (SEW) nursery facility at Kansas State University. Pigs were housed in a 5 × 5 ft pen containing one self-feeder and one nipple drinker to provide *ad libitum* access to feed and water. From d 1 to 10, both dry and liquid feeders were weighed daily. Average daily gain and F/G were determined by weighing pigs and feeders on d 3, 7, 10, 14, 21, and 28 after weaning. Average DMI was calculated on a DM basis. Data from this experiment were analyzed as a randomized complete-block design by the MIXED procedure of SAS, with pen as the experimental unit.

## Results and Discussion

The effects on post-weaning pig performance of feeding a combination of a complete liquid (Neolac) and dry feed for various durations are presented in Tables 2 and 3. From d 0 to 3, physical form of the diet had a significant effect on growth performance. Pigs on liquid feed had 60% greater ADG ( $P<0.01$ ; Table 2) than that of pigs fed the dry pellets. This can be attributed to the higher DMI ( $P<0.01$ ) for liquid-fed pigs, compared with that of the dry-fed pigs. Dry matter intake of pigs on the liquid feed was three times greater ( $P<0.01$ ) than the intake of the dry-fed controls 3 d after weaning (0.60 vs. 0.21 lb/d). But total DMI of pigs fed the liquid-dry feed combination decreased in the first 3 d (Figures 1 and 2), and the difference in DMI between treatments was mainly observed during the first 2 d after weaning (Figure 3). Moreover, liquid-fed pigs had higher DM F/G ( $P<0.01$ ) than did dry-fed pigs (0.80 vs. 0.46).

From d 4 to 7, pigs on the liquid diet for 7 d had the same ADG as the dry-fed controls did, despite having a higher DMI (0.59 vs.

0.43 lb/d;  $P<0.03$ ). Pigs on the liquid-dry feed combination for the first 3 d had a significantly lower ADG ( $P<0.01$ ), growing by only 45% of the growth rate of the dry-fed controls (0.49 vs. 0.22 lb/d). This may be due to liquid-fed pigs having a lower DMI ( $P<0.03$ ) than the dry-fed pigs did after removal of the liquid feed.

From d 8 to 10, ADG of pigs fed the liquid-dry feed combination for 7 d was 40% lower ( $P<0.01$ ) than that of pigs fed only dry feed (0.57 vs. 0.34 lb/d). These reductions in daily gain can also be attributed to the significant reduction ( $P<0.01$ ) in DMI after removal of the liquid feed. But pigs were able to regain normal feed intake 3 to 4 d after liquid feed removal. From d 14 to 28, no differences were observed in ADG and DM feed/gain among the treatments.

For pigs on the liquid diet, liquid feed intake contributed between 72 and 95% of the total DMI in the first week after weaning, but its contribution declined as the pigs aged (Figures 1 and 2). On the other hand, the contribution of dry feed to total DMI increased from 5% in d 2 to 28% in d 6 for pigs fed liquid feed for 7 d. For the dry-fed pigs, total DMI increased linearly in the first 10 d after weaning (Figure 3). In liquid-fed pigs, total DMI decreased in d 4 and 8 after liquid feeding was terminated at d 3 and 7, respectively. This reduction in DMI may indicate that pigs were adjusting to the removal of the liquid feed, which resulted in the loss of differences in weight gain. These pigs obtained similar DMI as the dry-fed controls by d 10 after weaning.

Overall, ADG of pigs fed the liquid-dry feed combination was only greater ( $P<0.01$ ) until d 7 after weaning (Table 3). No differences in overall ADG were observed from d 0 to 10, 14, 21, or 28. Dry matter intake increased as a result of liquid feeding. For pigs provided with liquid feed for 3 d, DMI remained higher until d 10 ( $P<0.02$ ) than the DMI of pigs fed only dry feed. Pigs given liquid feed for 7 days had consistently higher DMI ( $P<0.06$ ) until d 14 than the DMI of pigs fed dry feed only. No differences in DMI were observed at d 21 and 28. Overall, DM F/G was higher in pigs fed liquid feed. In pigs given 3 d of liquid feed, DM F/G remained higher ( $P<0.03$ ) than that of the dry-fed controls until d 21. Pigs provided liquid feed for 7 d consistently had a higher DM F/G ( $P<0.06$ ) than that of the dry-fed controls in all periods.

Liquid feeding, in combination with dry feeding, can improve growth rates of pigs immediately after weaning. This can be attributed mainly to a large improvement in dry matter intake. But liquid feeding led to undesirable DM F/G, and its effect persisted 3 weeks after the removal of the liquid feed. Weight gains obtained during the first 3 d after weaning with the liquid feed did not persist until the end of the nursery period, regardless of the duration of liquid feeding. Further research is needed to determine whether the improvement in initial feed intake with liquid feeding will reduce “starve-outs” and mortality, or whether changes in composition of the liquid feed would allow the weight gain advantage to be maintained through the entire nursery period.

**Table 1. Diet Composition (As-fed Basis)**

Item	SEW	Transition	Phase 2
Corn	34.70	37.15	52.28
Soybean meal, 46.5%	12.55	20.06	26.65
Spray-dried porcine plasma	6.70	2.50	-
Select menhaden fish meal	6.00	5.00	4.50
Spray-dried blood cells	1.65	1.25	-
Spray-dried whey	2.50	25.00	10.00
Lactose	5.00	-	-
Choice white grease	5.00	5.00	3.00
Monocalcium phosphate, 21% P	0.30	0.70	0.55
Limestone	0.45	0.45	0.50
Salt	0.25	0.30	0.30
Zinc oxide	0.37	0.38	0.25
Vitamin premix with phytase	0.25	0.25	0.25
Trace mineral premix	0.15	0.15	0.15
L-lysine HCl	0.15	0.26	0.30
DL-methionine	0.15	0.18	0.15
L-threonine	0.08	0.13	0.13
Antibiotic	1.00	1.00	1.00
Acidifier	0.20	0.20	-
Vitamin E	0.05	0.05	-
Total	100.00	100.00	100.00
Calculated Analysis			
TID lysine, %	1.56	1.51	1.35
Total lysine, %	1.70	1.65	1.48
Total lysine:protein ratio, %	7.52	7.43	6.95
ME, kcal/lb	1,591	1,575	1,553
Protein, %	22.6	22.2	21.3
Ca, %	0.79	0.83	0.71
P, %	0.73	0.77	0.65
Available P, %	0.55	0.55	0.38
Lysine:calorie, g/Mcal	4.85	4.75	4.33
Na, %	0.58	0.47	0.25
Cl, %	0.71	0.70	0.45
K, %	0.94	1.09	0.97

**Table 2. Effect on Post-weaning Performance of Feeding a Complete Liquid (Neolac) and Dry Feed Combination for Various Durations<sup>a</sup>**

Treatment <sup>b</sup>	Dry Feed	Liquid Feeding Duration, d		SE	Probability, P <
		3	7		
DMI, lb/d <sup>c</sup>					
Day 0 to 3	0.209 <sup>d</sup>	0.630 <sup>e</sup>	0.590 <sup>e</sup>	0.035	0.01
Day 4 to 7	0.429 <sup>d</sup>	0.310 <sup>e</sup>	0.595 <sup>f</sup>	0.050	0.03
Day 8 to 10	0.673 <sup>d</sup>	0.658 <sup>d</sup>	0.531 <sup>e</sup>	0.042	0.01
Day 11 to 14	0.936 <sup>d</sup>	0.843 <sup>d</sup>	0.771 <sup>e</sup>	0.080	0.03
Day 15 to 21	1.299	1.293	1.294	0.059	0.99
Day 22 to 28	1.814	1.666	1.776	0.101	0.31
ADG, lb					
Day 0 to 3	0.497 <sup>d</sup>	0.821 <sup>e</sup>	0.772 <sup>e</sup>	0.065	0.01
Day 4 to 7	0.490 <sup>d</sup>	0.222 <sup>e</sup>	0.460 <sup>d</sup>	0.048	0.01
Day 8 to 10	0.567 <sup>d</sup>	0.618 <sup>d</sup>	0.337 <sup>e</sup>	0.052	0.01
Day 11 to 14	0.745	0.744	0.706	0.047	0.57
Day 15 to 21	1.079	1.010	1.054	0.056	0.41
Day 22 to 28	1.236	1.200	1.264	0.053	0.40
F/G <sup>g</sup>					
Day 0 to 3	0.462 <sup>d</sup>	0.784 <sup>e</sup>	0.807 <sup>e</sup>	0.104	0.01
Day 4 to 7	0.900 <sup>d</sup>	2.231 <sup>e</sup>	1.346 <sup>d</sup>	0.635	0.05
Day 8 to 10	1.190	1.083	4.330	3.660	0.47
Day 11 to 14	1.262	1.165	1.104	0.115	0.30
Day 15 to 21	1.212	1.296	1.229	0.048	0.19
Day 22 to 28	1.467	1.391	1.401	0.055	0.32

<sup>a</sup>A total of 180 pigs, initial wt = 11.4 lb (PIC L337 × C22); values are means of 9 pens (for dry feed, 3 d liquid feeding) and 18 pens (7 d liquid feeding) of 5 pigs each, respectively.

<sup>b</sup>Liquid feed (Neolac) provided with the dry feed for 3 or 7 days after weaning.

<sup>c</sup>Average daily feed intake was calculated on a dry matter basis.

<sup>d,e,f</sup>Means in the same row with different superscript differ.

<sup>g</sup>F/G was calculated as DMI divided by ADG.

**Table 3. Effect on Overall Post-weaning Performance of Feeding a Complete Liquid (Neolac) and Dry Feed Combination for Various Durations<sup>a</sup>**

Treatment <sup>b</sup>	Dry Feed	Liquid Feeding Duration, d		SE	Probability, P <
		3	7		
DMI, lb/d <sup>c</sup>					
Day 0 to 7	0.335 <sup>d</sup>	0.447 <sup>e</sup>	0.593 <sup>f</sup>	0.033	0.01
Day 0 to 10	0.412 <sup>d</sup>	0.487 <sup>e</sup>	0.556 <sup>f</sup>	0.029	0.02
Day 0 to 14	0.530 <sup>d</sup>	0.560 <sup>de</sup>	0.591 <sup>e</sup>	0.036	0.06
Day 0 to 21	0.734	0.752	0.774	0.028	0.28
Day 0 to 28	0.950	0.931	0.971	0.041	0.52
ADG, lb					
Day 0 to 7	0.493 <sup>d</sup>	0.479 <sup>d</sup>	0.593 <sup>e</sup>	0.028	0.01
Day 0 to 10	0.515	0.521	0.517	0.028	0.98
Day 0 to 14	0.581	0.585	0.571	0.031	0.86
Day 0 to 21	0.747	0.726	0.732	0.032	0.80
Day 0 to 28	0.869	0.845	0.865	0.032	0.72
F/G <sup>g</sup>					
Day 0 to 7	0.679 <sup>d</sup>	0.941 <sup>e</sup>	1.003 <sup>e</sup>	0.054	0.01
Day 0 to 10	0.799 <sup>d</sup>	0.939 <sup>e</sup>	1.082 <sup>f</sup>	0.041	0.01
Day 0 to 14	0.911 <sup>d</sup>	0.966 <sup>de</sup>	1.040 <sup>e</sup>	0.055	0.02
Day 0 to 21	0.984 <sup>d</sup>	1.044 <sup>e</sup>	1.058 <sup>e</sup>	0.025	0.03
Day 0 to 28	1.091 <sup>d</sup>	1.102 <sup>de</sup>	1.121 <sup>e</sup>	0.015	0.06

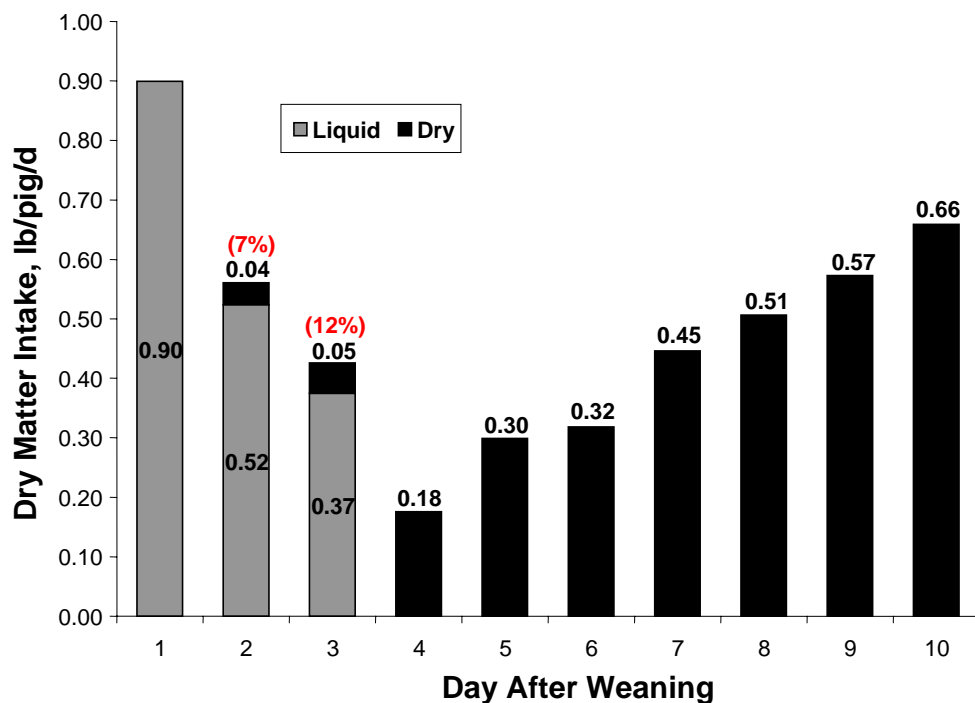
<sup>a</sup>A total of 180 pigs, initial wt = 11.4 lb (PIC L337 × C22); values are means of 9 pens (for dry feed, 3 d liquid feeding) and 18 pens (7 d liquid feeding) of 5 pigs each, respectively.

<sup>b</sup>Liquid feed (Neolac) provided with the dry feed for 3 or 7 days after weaning.

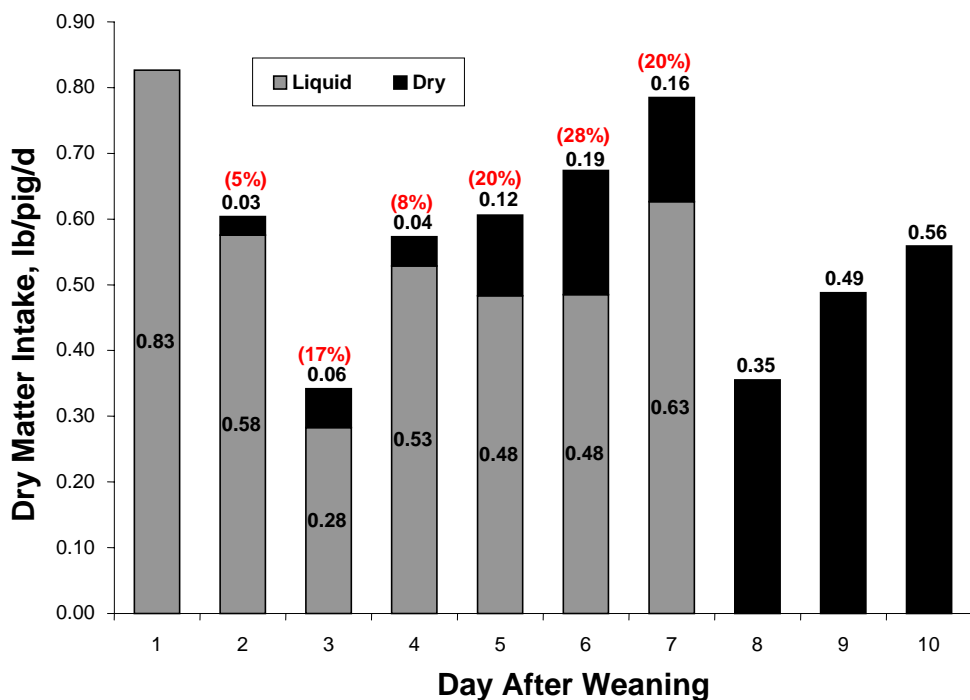
<sup>c</sup>Average daily feed intake was calculated on a dry matter basis.

<sup>d,e,f</sup>Means in the same row with different superscript differ.

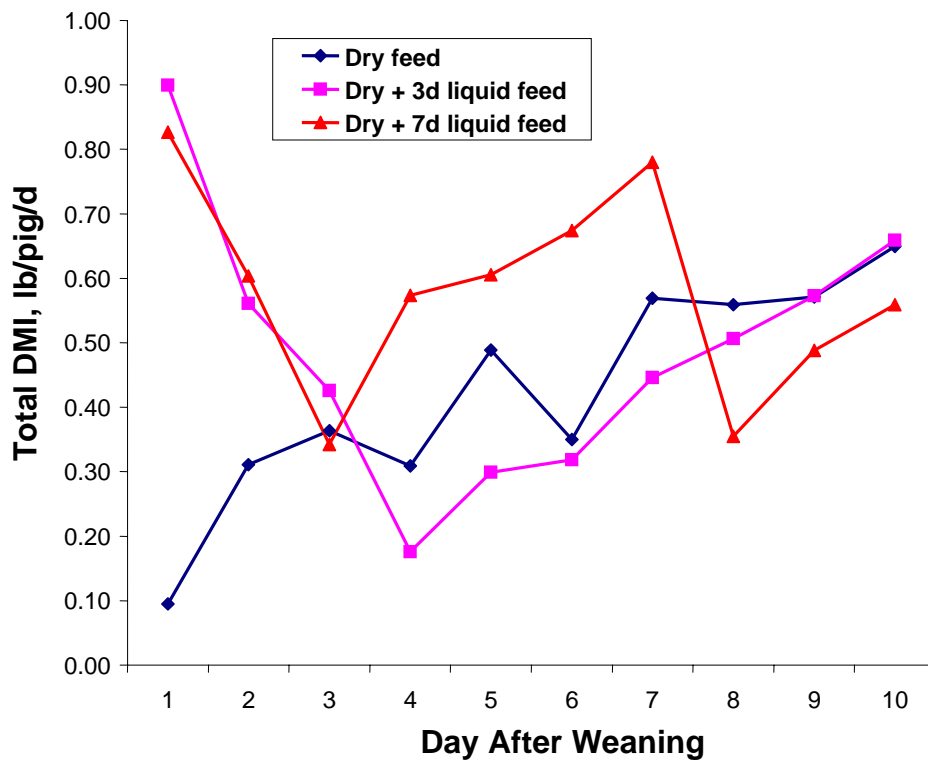
<sup>g</sup>F/G was calculated as DMI divided by ADG.



**Figure 1. Dry and Liquid Feed Intake (lb DM/pig/d) in Nursery Pigs Fed a Complete Liquid and Dry Feed Combination for 3 d during the First 10 d After Weaning (% of total DMI in parentheses).**



**Figure 2. Dry and Liquid Feed Intake (lb DM/pig/d) in Nursery Pigs Fed a Complete Liquid and Dry Feed Combination for 7 d during the First 10 d After Weaning (% of total DMI in parentheses).**



**Figure 3. Dry Matter Intake (lb/pig/d) of Nursery Pigs Fed Dry Feed Only or a Complete Liquid and Dry Feed Combination for 3 or 7 d during the First 10 d After Weaning.**