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WEANLING PIG RESPONSE WHEN NAKED OAT AND EXTRUDED FIELD PEA REPLACED CORN AND SOYBEAN MEAL IN THE DIETS OF SEGREGATED EARLY WEANED PIGS

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ABSTRACT

The complementary effect of feeding 20% extruded field pea and *Paul* oat on growth performance and feeding economics was evaluated using 160, 19-day old pigs, in a 28-day segregated early weaning (SEW) pig starter study. Corn, soybean meal (SBM), naked oat and 20% extruded field pea were used in 4-phase nutrient-dense diets to evaluate the following four protein/energy blends: Corn/soybean meal (Control), corn/20% extruded pea, naked oat/SBM and naked oat/20% extruded pea.

Each of the dietary growth phases were evaluated separately. We observed a considerable amount of variation among the growth criteria monitored, which were not always consistent from one phase to the other.

Overall, only subtle differences were observed in weanling pig response. A nutrient-dense naked oat/20% extruded pea blend generated pig performance that was equal to feeding a conventional corn/SBM control starter. This is of particular importance because the added investment for extrusion was cost- effective, demonstrating that field pea grown in North Dakota, and processed locally, can be competitive. Naked oat, as well, was a cost- effective ingredient that completely replaced corn and complemented both 20% extruded pea and soybean meal.

Based on the results of this study, and the separate investigations with field pea and naked oat reported by Landblom and Poland (1996 a, b), combinations of 20% extruded field pea and *Paul* oat when fed together or

separately can readily be used in the starter diets of SEW pigs.

INTRODUCTION

Field pea and naked oat are two alternative crops being grown in North Dakota for multiple markets. The principal market is human consumption, however, the crops are also being grown in rotations as a means to interrupt disease cycles, increase soil fertility (field pea) and for livestock feed.

A series of investigations, at the Dickinson Research and Extension Center, have focused on the utilization of raw and extruded field pea and *Paul* oat as replacements for corn and soybean meal (SBM) in the diets of segregated early weaned (SEW) pigs. The scientific literature, as it relates to field pea and the extrusion of field pea, has been discussed elsewhere in a report by Landblom and Poland (1996 a).

In the field pea studies, heat treatment of pea by extrusion improved weanling pig performance significantly. When corn and soybean meal were replaced with raw or extruded field pea in three experiments it was determined that diets for pigs weighing 11 pounds or less should not be formulated with raw pea until the pigs weigh at least 16 pounds, and that extruded pea can be included in the starter diet, but the level must also be restricted. For pigs weighing 16 pounds or greater, the upper limit of raw pea was found to be less than 20% (Canadian research recommends no more than 15% in the starter diet) of the total diet, and upper limit for extruded pea was found to be no more than 20% (Landblom and Poland, 1996 a).

When *Paul* oat replaced 0, 50, 75 and 100% of the corn and a portion of the soybean meal, pigs averaging 14 pounds at weaning, and receiving 75 and 100% naked oat performed equally to those pigs receiving corn and soybean meal. There was also a trend toward lower cost/pound of gain for those pigs fed the naked oat diet.

The purpose of the present investigation was to evaluate the complimentary effects of field pea and naked oat on growth performance and feeding economics when fed in combination to segregated early weaned pigs.

PROCEDURE

One-hundred-sixty, 19 day-old pigs, averaging 13 pounds at weaning were allotted to the following four treatments: corn/SBM (control), corn/20% extruded pea, naked oat/SBM and a naked oat/20% extruded pea, in a 4-phase, 28-day pig starter study. Four pen replicates were used with ten pigs per pen.

At weaning, pigs were vaccinated with a 3-way multivalent vaccine and moved to an environmentally-controlled, SEW facility, weighed and randomly assigned to treatments. Pigs were then introduced to a meal-type pre-starter diet formulated with the test ingredients. The test diets were formulated to contain the following crude protein and lysine levels: Phase 1 (24.2% CP, 1.90% lysine), Phase 2 (21.1% CP, 1.5% lysine), Phase 3 (19.2% CP, 1.30% lysine) and Phase 4 (19.4% CP, 1.25 lysine) and were fed for seven days in each phase (Table 1). Within each phase, naked oats or field peas were substituted for corn and soybean meal on a total protein basis. Synthetic lysine was used to provide equal lysine concentrations across diets within each phase. DL-methionine was added as necessary to provide a minimum of .83, .75, .73 and .62% methionine-cystine in Phase 1, 2, 3 and 4, respectively. All other amino acid concentrations were provided for by dietary ingredients without regard to their ratio to lysine.

Peas were extruded by Maertens Manufacturing Company, Center, ND, using an Insta-Pro® extruder. Prior to extrusion, pea grain was ground through a number 4, full circle screen, and 5% sunflower oil was added to reduce starch expansion. Temperature of the extruded pea material, as it left the extruder barrel, was 275F ®15F. After extrusion, the extruded pea material was re-ground through a " screen using a New Holland grinder/mixer and mixed into the nutrient-dense, 4-phase starter diets.

Data was analyzed using GLM procedures of SAS (SAS, 1988).

RESULTS AND DISCUSSION

A considerable amount of change was noticed within the individual growth phases, as shown in Table 2, but the source of change was not consistent between phases.

In the first post-weaning phase, there was no difference between SBM and 20% extruded pea diets with respect to gain, but diets formulated with corn supported better gain than *Paul* oat (P<.05). Soybean meal didn't complement

naked oat as well as 20% extruded pea. Pigs fed the naked oat/SBM starter consumed the least amount of feed, grew at a slower rate , had the lowest gain to feed ratio and the highest feed cost/pound of gain (P<.05). By contrast, pigs fed the corn/SBM control grew at the fastest rate and were the most efficient (P<.05).

In the second phase, gain, ADFI and G:F were not different among any of the diets. Pigs fed the naked oat/SBM tended to numerically recover from the slower start recorded in phase one. This apparent compensatory growth enabled the naked oat/SBM pigs to be significantly more cost efficient (P<.05).

In the third phase, pigs in all treatments were well established on feed. No interactions were measured. Diets that contained SBM had higher ADFI (P<.05), and those containing corn had higher gain to feed ratios (P<.05). As a result, those diets formulated with corn were more cost efficient with respect to feed cost/pound of gain.

Numerical differences were measured in the fourth phase for all criteria evaluated, but the only significant difference measured was for ADFI. Pigs receiving diets containing SBM consumed more feed than those pigs receiving 20% extruded pea diets, but gain to feed ratio was lower, which translated into poorer feed efficiency and higher feed cost/pound of gain. Pigs fed diets containing 20% extruded pea consumed slightly less feed/day, but had numerically higher gain to feed ratios and lower feed cost/pound of gain.

When growth phases for the 28-day starter period were combined, gains were not affected by dietary treatment. Treatment interactions for feed consumption revealed greater pig preference for those diets in which corn was blended with SBM and naked oat was blended with 20% extruded pea. Numerically lower feed costs/pound of gain were obtained when corn was blended with 20% extruded pea and naked oat was blended with soybean meal, however this lower cost was also associated with lower feed intake.

IMPLICATION

This evaluation of nutrient complementarily in SEW pig starter diets revealed only subtle differences in weanling pig response. A nutrient-dense naked oat/20% extruded pea blend generated pig performance that was equal to feeding a conventional corn/SBM pig starter. This is of particular importance because the added investment for extrusion was cost-effective. This demonstrates that field pea grown in North Dakota and processed locally can be a

competitive feedstuff. Naked oat, as well, was a cost-effective feed ingredient.

Based on the results of this study, and the separate investigations with field pea and naked oat reported by Landblom and Poland (1996 a,b), combinations of 20% extruded field pea and *Paul* naked oat, when fed together, or separately, can be readily used in the starter diets of SEW pigs.

Table 1. Four-phase pig starter diets formulated with corn, soybean meal, extruded field pea and *Paul* naked oat

	Corn/Soybean Meal				Corn/20% Ext. Pea				Naked Oat/Soybean Mean				Naked Oat/20% Ext. Pea			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
INGREDIENTS, %																
Naked Oat	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	40.3	52.0	63.8	79.6	22.4	38.4	51.2	63.9
Extruded Pea	0.0	0.0	0.0	0.0	20.0	20.0	20.0	20.0	0.0	0.0	0.0	0.0	20.0	20.0	20.0	20.0
Corn	31.1	40.5	50.4	61.9	18.9	28.3	37.7	49.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dried Whey	25.0	18.0	10.0	0.0	25.0	18.0	10.0	0.0	25.0	18.0	10.0	0.0	25.0	18.0	10.0	0.0
Fish Meal	10.0	5.0	4.0	4.0	10.0	5.0	4.0	4.0	10.0	5.0	4.0	4.0	9.0	7.5	7.5	4.0
Soybean Meal	11.0	21.0	25.0	26.0	2.5	12.5	16.8	17.0	2.0	9.5	11.5	8.5	0.0	0.0	0.0	3.0
Blood Plasma	10.0	4.0	0.0	0.0	10.0	4.0	0.0	0.0	10.0	4.0	0.0	0.0	10.0	4.0	0.0	0.0
Lysine	.2	.15	.29	.2	.15	.1	.22	.16	.33	.37	.52	.52	.18	.25	.45	.42
Methionine	0.0	.15	.2	.1	0.0	.15	.27	.2	0.0	.15	.27	.1	0.0	.15	.27	.2
Mineral	0	0	0	1.0	0	0	0	1.0	0	0	0	1.0	0	0	0	1.0

Premix	.9	.9	.9	1.0	.9	.9	.9	1.0	.9	.9	.9	1.0	.9	.9	.9	1.0
Limestone	0.0	0.0	.3	.3	0.0	0.0	.3	.4	0.0	0.0	.3	.3	0.0	0.0	.3	.4
Dical	0.0	.5	.65	.75	0.0	.5	.65	.75	0.0	.5	.65	.75	0.0	.5	.65	.75
sunflower Oil	9.5	7.5	6.0	4.0	10.3	8.3	6.9	5.0	9.2	7.3	5.8	3.5	10.2	8.0	6.5	4.6
Other[a]	2.28	2.28	2.28	1.78	2.28	2.28	2.28	1.78	2.28	2.28	2.28	1.78	2.28	2.28	2.28	1.78
ANALYSIS, %																
Crude Protein	24.2	21.1	19.2	19.4	24.3	21.1	19.4	19.3	24.2	21.1	19.5	19.5	24.5	21.1	19.4	19.4
Lysine	1.9	1.5	1.3	1.25	1.9	1.5	1.3	1.25	1.9	1.5	1.3	1.25	1.9	1.5	1.3	1.25
Tryptophan	.35	.29	.25	.25	.33	.27	.23	.23	.33	.28	.24	.23	.33	.26	.21	.22
Meth.+Cyst.	.96	.89	.82	.74	.86	.79	.79	.73	.89	.81	.78	.62	.83	.75	.73	.62
Calcium	.93	.76	.8	.77	.92	.76	.80	.80	.93	.77	.81	.77	.88	.88	.97	.80
Avail. Phos.	.55	.48	.45	.42	.54	.47	.44	.41	.56	.5	.46	.45	.52	.55	.55	.44
Energy, kcal ME/lb	1635	1584	1548	1535	1635	1584	1548	1535	1635	1585	1548	1535	1635	1584	1549	1535

[a]Includes: 1.22% Mecadox premix, .05% copper sulfate, .8% zinc sulfate in phases 1-3, .16% vit. B complex, .05% vit. A, D and E and .3% salt in phase 4

Table 2. Pig performance by phase when naked oat and field pea replaced corn and soybean meal in four pig starter formulations.

	Corn/Soybean Meal	Corn/20% Extruded Pea	Naked Oat/ Soybean Meal	Naked Oat/ 20% Ext. Pea	SE
Phase 1 (7 Days)					
Starting Weight, lb.	13 .1	13.2	13.2	13.1	
Ending Weight, lb.	15.9	15.6	15.0	15.4	
Gain, lb.[b,c]	2.8	2.4	1.75	2.3	.22
ADG, lb.[b,c]	.40	.34	.25	.33	.037
ADFI, lb.	.57	.56	.51	.57	.021
G:F, lb.[b]	.70	.61	.49	.58	.048
Feed Cost/lb. of Gain[b,c]	$.66	$.75	$.93	$.79	.050
Phase 2 (6 Days)					
Starting Weight, lb.	15.9	15.6	15.0	15.4	
Ending Weight, lb.	20.2	20.0	19.9	19.9	
Gain, lb.	4.3	4.4	4.9	4.5	.34
ADG, lb.	.71	.73	.81	.75	.056
ADFI, lb.	1.06	1.04	1.03	1.08	.051
G:F, lb.	.67	.70	.79	.69	.027
Feed Cost/lb. of Gain[c]	$.42	$.41	$.36	$.41	.016

Phase 3 (7 Days)					
Starting Weight, lb.	20.2	20.0	19.9	19.9	
Ending Weight, lb.	27.2	26.5	26.1	26.3	
Gain, lb.	7.0	6.5	6.2	6.4	.23
ADG, lb.	1.0	.93	.88	.91	.033
ADFI, lb.[a]	1.57	1.41	1.56	1.50	.028
G:F, lb.[b]	.64	.66	.56	.61	.023
Feed Cost/lb. of Gain[b]	$.26	$.25	$.29	$.28	.012
Phase 4 (8 Days)					
Starting Weight, lb.	27.2	26.5	26.5	26.3	
Ending Weight, lb.	34.2	33.7	33.6	34.1	
Gain, lb.	7.0	7.2	7.5	7.8	.44
ADG, lb.	.88	.90	.94	.98	.055
ADFI, lb.[a,c]	1.79	1.62	1.72	1.71	.033
G:F, lb.	.49	.56	.55	.57	.036
Feed Cost/lb. of Gain	$.27	$.25	$.24	$.23	.027

[a] Treatments containing extruded pea differ from those containing soybean meal (P<.05).
[b] Treatments containing naked oat differ from those containing corn (P<.05).
[c] Treatment interaction: at least one mean within the row differs (P<.05).

Table 3. Combined segregated early weaning pig performance when naked oats and 20% field pea replace corn and soybean meal (28-day starter period)

	Corn/Soybean Meal	Corn/20% Extruded Pea	Naked Oat/ Soybean Meal	Naked Oat/ 20% Ext. Pea	SE
GROWTH PERFORMANCE:					
Starting Weight, lb.	13.1	13.2	13.2	13.1	
28-Day Weight, lb.	34.2	33.7	33.6	34.1	
Gain/Head, lb.	21.1	20.5	20.4	21.0	.50
ADG, lb.	.75	.73	.73	.75	.02
FEEDING ECONOMICS:					
Feed/Head, lb.[c]	35.7	33.0	34.5	34.6	.65
ADFI, lb.[c]	1.27	1.18	1.23	1.24	.023
G:F, lb.	.59	.62	.59	.61	.011
Feed Cost/Head[c]	$7.39	$6.98	$6.90	$7.27	.157
Feed cost/Lb. of Gain	$.35	$.34	$.34	$.35	.005

c Treatment interaction: at least one mean within the row differs (P<.05).

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