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PIG RESPONSE TO REPLACEMENT OF CORN AND SBM WITH *PAUL* NAKED OAT IN SEGREGATED EARLY WEANING PIG STARTER DIETS

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ABSTRACT

Three-phase segregated early weaning (SEW) pig starter diets were evaluated for pigs averaging 19 days of age and weighing 14 pounds when Paul oat, a new NDSU hull-less oat release, replaced 0, 50, 75 and 100% of the corn fraction and a portion of the soybean (SBM) in a 29 day pig starter study.

When naked oat replaced 50% of the corn, depressed performance was observed that cannot be explained. In the first two phases, there was a numerical trend toward slower average daily gain (ADG) and lower average daily feed intake (ADFI), however in the third phase ADG was also slower, but ADFI was significantly higher compared to diets formulated with either 100% corn or 100% naked oat. Over the 29 day starter period, a compounding affect between ADG and ADFI resulted in the lowest gain to feed ratio (G:F) ($P<.05$) and highest feed cost per pound of gain ($P<.05$) when compared to feeding either 100% corn or 100% naked oat.

Differences in starter diets formulated with either 100% corn or 75 and 100% naked oat were not significant.

Implications from this research suggest that the naked oat variety, *Paul,* can replace all of the corn and a portion of the SBM in 3-phase SEW pig starter diets. Due to its adaptability as a locally grown cool-season crop, it will likely be grown as a lower-cost energy/protein alternative to shipping in corn and SBM.

INTRODUCTION

Conventional oats have not normally been used as an energy source in swine production because of their high hull content, which lowers digestibility and overall nutritive value for swine.

Plant breeders in the US and Canada have been developing naked, or hull-less, oat varieties for a number of years. Hull-less or naked oats do have hulls, but because they are loosely attached they are rubbed off and blown away during combining. Conventional oats possess 25-30% hull whereas naked oats may have as little as 5% of a thin hull remaining after harvesting.

Low yield has been the major factor keeping farmers from growing naked oat to any great extent. Recently, breeding efforts by NDSU scientists resulted in the newest oat release, *Paul. Paul* oat not only yields better, but is considered to be a nutrient dense feedstuff with a potential to replace a portion of the soybean and corn in commonly used pig diets.

Naked oats have been fed as a replacement for corn and soybean meal in diets for broiler chicks and pigs (Christison and Bell, 1980, Myer et al., 1985, Friend et al., 1988 and Swantek et al., 1995). Fowler (1985) fed *Tibor* naked oat, oat flake, wheat and corn in fortified weanling pig diets and observed poorer daily gain and feed efficiency among the naked oat fed pigs than those receiving corn. The author attributed slower growth performance to the presence of beta-glucans, gummy polysacchaids that interfere with digestion.

Compared to conventional oats, naked oats have approximately 12% less fiber and 30-35% higher digestible energy (3,200 - 3,700 kcal/kg). Crude protein and oil contents are also higher, averaging about 15% and 9.5%, respectively. Amino acid balance is favorable with lysine and methionine being the only amino acids not present in sufficient amounts to meet requirements for growing pigs. Vitamin and mineral content is slightly higher because the diluting effect of the hull has been removed.

This study was conducted to determine if the new NDSU naked oat release, *Paul* could replace a portion of the protein and all of the corn in SEW starter diets.

PROCEDURE

Paul oat was used to replaced 0, 50, 75 and 100% of the corn and a portion of the SBM in 3-phase pig starter diets. Conducted at the Dickinson Research and Extension Center's segregated early weaning facility, 128 PIC 326 x Camborough-15 piglets averaging 19.6 days of age and 14 pounds per head were allotted to one of the four treatments in a 29-day starter study. There were four pens per treatment and 8 pigs per pen.

Meal-type, 3-phase diets, detailed in Table 1, were formulated and fed as follows: Phase-1 (22.2% CP, 1.6% Lys., 1585 kcal ME/lb) was fed for 9 days, Phase-2 (20.2% CP, 1.4% Lys., 1545 kcal ME/lb) was fed for 13 days and phase-3 (19.2% CP, 1.27% lys., 1562 kcal ME/lb) was fed for 7 days. Pigs and feed were weighed with each phase change and at the end of the study. Dried whey, fish meal and animal plasma were included in the Phase 1 and 2 diets. Soybean meal was adjusted to provide a constant crude protein concentration across diets within each phase. Synthetic lysine was used to equalize lysine levels across diets. DL-methionine was added as necessary to provide a minimum of .80, .60 and.55% methionine+cystine in Phase 1, 2, and 3 diets, respectively. All other amino acids were provided by dietary ingredients with no consideration given to their ratio to lysine.

Initial Nursery room temperature (Initial = 83^{o} F) was set to reduce automatically .3^{o} F/day. Test pigs were housed in 4' x 4' pens, and the experimental diets were fed in nursery type stainless steel feeders. Pigs had access to double nipple waterers.

Data were analyzed using GLM procedures of SAS (SAS 1988).

RESULTS AND DISCUSSION

Weanling pig performance by phase is shown in Table 2. With respect to performance within dietary phase, phase-1 growth was slow but typical of freshly weaned, 19-day old pigs. Pig consumption of either the 100% corn or 100% *Paul* oat diets was identical suggesting that both grain bases support a smooth pig transition from nursing through acclimation to dry feed. Although slight growth differences were observed, no statistical differences were measured for ADG, ADFI, or gain:feed. Similar trends were observed in phase 2.

During phase-3, pigs fed the 50% naked oat diet consumed significantly more feed than the all corn and all naked oat treatments, but ADG and G:F did not improve suggesting that the apparent increased feed consumption may have been a function of undetected feed waste.

Combined 29-day performance revealed only subtle differences between the various levels of *Paul* oat fed and the corn control diet. When *Paul* oat replaced 75% and 100% of the corn fraction and a portion of the SBM, pig performance was equal. However, we observed a slight, but consistent, depression in performance when 50% of the corn was replace with naked oat. We have no explanation for the depression, but the trends toward slower ADG and higher ADFI, compared to the all corn and all naked oat diets, resulted in the lowest gain to feed ratio ($P<.05$) and the highest feed cost/pound of gain ($P<.05$).

Economically, pigs consuming the all *Paul* oat diet were the most cost efficient with respect to feed cost/pound of gain. Feed cost/pound of gain for the all corn control diet was intermediate between 50 and 100% *Paul* oat diets.

IMPLICATION

Implications from this research suggest that the naked oat variety, *Paul,* can replace all of the corn and a portion of the SBM in 3-phase SEW pig starter diets. Given varying market conditions, it will likely be included in starter diets as a lower-cost feedstuff because of its adaptability as a cool-season crop that doesn't have to be shipped into the area.

Table 1. Three-phase pig starter diets and calculated nutrient analysis.

PHASE:	0% Naked Oat			50% Naked Oat			75% Naked Oat			100% Naked Oat		
	1	2	3	1	2	3	1	2	3	1	2	3
INGREDIENTS, %:												
Naked Oat	0.0	0.0	0.0	22.9	27.9	32.5	36.5	45.5	52.0	54.5	67.9	74.9

Corn	39.0	46.6	57.5	22.9	27.9	32.4	13.6	15.2	17.2	0.0	0.0	0.0
Dried Whey	25.0	10.0	0.0	25.0	10.0	0.0	25.0	10.0	0.0	25.0	10.0	0.0
Fish Meal	11.0	0.0	0.0	11.0	0.0	0.0	10.5	0.0	0.0	10.0	0.0	0.0
Soybean Meal	11.0	33.3	31.9	6.0	26.5	24.6	3.0	22.3	20.3	0.0	17.0	15.0
Blood Plasma	5.0	0.0	0.0	5.0	0.0	0.0	5.0	0.0	0.0	5.0	0.0	0.0
Lysine	.12	.29	.26	.20	.42	.40	.28	.50	.47	.35	.60	.60
Methionine	0.0	.065	.07	0.0	.065	.07	.05	.075	.07	.05	.08	.07
Mineral Premix	.65	.65	.75	.65	.65	.75	.65	.65	.75	.65	.65	.75
Limestone	.50	.35	.60	.50	.35	.60	0.0	.35	.60	0.0	.35	.60
Dical	0.0	1.5	1.2	0.0	1.5	1.2	.50	2.0	1.2	.50	2.0	1.0
Salt	0.0	.05	.20	0.0	.05	.20	0.0	0.0	.20	0.0	0.0	.20
Sunflower Oil	6.5	5.9	6.1	4.5	3.2	5.9	3.5	2.0	5.8	2.51	0.0	5.5
Other[a]	1.44	1.44	1.44	1.44	1.44	1.44	1.44	1.44	1.44	1.44	1.44	1.44
ANALYSIS, %:												
Crude Protein	22.1	20.2	19.2	22.3	20.2	19.2	22.3	20.2	19.2	22.4	20.3	19.2
Lysine	1.6	1.4	1.27	1.6	1.4	1.27	1.6	1.4	1.27	1.6	1.4	1.27

Tryptophan	.29	.27	.26	.29	.26	.25	.28	.26	.25	.28	.25	.24
Methionine + Cyst.	.84	.67	.67	.81	.65	.62	.83	.63	.58	.80	.60	.55
Calcium	1.1	.83	.76	1.1	.82	.77	1.0	.95	.77	1.0	.95	.72
Avail. Phos.	.59	.43	.38	.57	.41	.39	.63	.48	.40	.61	.46	.37
Energy, kcal ME/lb	1584.0	1545.0	1562.0	1585.0	1545.0	1562.0	1590.0	1545.0	1562.0	1601.0	1545.0	1563.0
[a]Includes 1.22% Carbadox, .06% copper sulfate, .07% vitamin B complex, .07% vitamin A,D,E and .02% zinc sulfate.												

Table 2. Pig performance by phase when starter diets contained increasing levels of *Paul* naked oat.

	Paul Oat %				
CRITERIA	0%	50%	75%	100%	SEM
PHASE 1 (9 days)					
Start Wt.	14.2	14.1	14.3	14.1	
End Wt.	17.0	16.2	16.7	17.2	
Gain	2.8	2.1	2.4	3.1	
ADG	.31	.22	.26	.35	.041
ADFI	.47	.44	.46	.54	.066

G:F	.66	.50	.56	.65	.034
PHASE 2 (13 days)					
Start Wt.	17.0	16.2	16.7	17.2	
End Wt.	25.1	23.1	24.0	26.9	
Gain	8.1	6.9	7.3	9.7	
ADG	.63	.53	.56	.67	.041
ADFI	1.06	1.03	1.04	1.15	.066
G:F	.59	.52	.54	.58	.034
PHASE 3 (7 days)					
Start Wt.	25.1	23.1	24.0	26.9	
End Wt.	30.8	28.5	30.3	32.0	
Gain	5.7	5.4	6.3	5.1	
ADG	.80	.78	.91	.85	.041
ADFI	1.52a	1.77^{b}	1.62^{ab}	1.57^{a}	.066
G:F	.53	.44	.56	.54	.034
[a,b] Means with unlike superscripts differ (P<.05).					

Table 3. Segregated early weaning pig performance when *Paul* naked oat replaced 0, 50,

75 and 100% of the corn (29 Day Period)

Criteria	Paul Oat % 0%	50%	75%	100%	SEM	P-Value
Start Wt., lbs.	14.2	14.1	14.3	14.1		
End Wt., lbs.	30.8	28.5	30.3	32.0		
Gain, lbs.	16.6	14.4	16.0	17.9	2.89	.20
ADG, lbs	.57	.50	.55	.62	.039	.36
ADFI, lbs.	.99	1.03	1.00	1.06	.051	.58
Gain:Feed, lbs.	.58[a]	.49[b]	.55[ab]	.58[a]	.025	.035
Fd Cost:gain	$.26[ab]	$.29[b]	$.25[ab]	$.23[a]	.016	.056

[a,b] Rows with unlike superscripts differ (P<05).

LITERATURE CITED

Christison, G.I. and J. M. Bell. 1980. Evaluation of Terra, a new cultivar of naked oats (avena nuda), when fed to young pigs and chicks. Can J. Anim. Sci. 60:465-471.

Friend, D.W., A. Fortin, L.M. Poste, G. Butler, J.K. Kramer and V.D. Burrows. 1988. Feeding and metabolism trials and assessment of carcass and meat quality for growing-finishing pigs fed naked oats. Can. J. Anim. Sci. 68:511-522.

Myer, R.O, R.D. Barnett and W.R. Walker. 1985. Evaluation of hull-less oats in diets for young swine. Nutr. Rept. Int. 32:1273-1277.

SAS. 1988. SAS User's Guide: Statistics. SAS Inst. Inc., Cary NC.

Swantek, P.M., R. Zimprich, R. Harrold, J. Tilton, L. Stearns and T. Petry. 1996. Growth performance of pigs fed *Paul*, a new naked oat cultivar. Unpublished data.

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