Evaluation of Nutridense Corn and Normal Corn for Grow-Finish Pigs

B. E. Hill, C. T. Herr, S. L. Hankins, S. A. DeCamp, and B. T. Richert
Department of Animal Sciences, Purdue University

Introduction

Nutridense corn is a specialty type hybrid of yellow corn that possesses a higher oil, crude protein, and amino acid profile than that of normal yellow corn. Because of the increased content of nutrients on a pound for pound basis, feeding nutridense corn may be a viable method to improve feed efficiency and reduce expensive fat and protein inputs for pork producers.

A grow-finish pig study was conducted to evaluate the effects of nutridense corn and normal corn during the grower and finisher phases on average daily gain (ADG), average daily feed intake (ADFI), feed efficiency (G:F), 10^{th} rib fat depth, loin depth, hot carcass weight, premium, and percent lean. The trial was conducted from August to December 2000.

Experimental Procedures

Five dietary treatments were formulated using normal corn (NC) and nutridense corn (NDC) and fed during a 12-week period. Treatments were as follows: A) Industry standard NC; B) NDC on a pound for pound substitution for NC; C) NDC formulated to the same lysine level as diet A; D) NC with supplemental fat to make it isolipid to Diet B; and E) NDC with extra synthetic lysine to replace more soybean meal and further reduce dietary crude protein. Diets were changed every three weeks to create two grower and two finisher diets. The diets were formulated to meet or exceed the nutrient requirements for each sex and phase of growth (Table 1) based on the NRC (1998).

One hundred and ninety pigs (95 barrows and 95 gilts) were blocked by sex, ancestry, and weight into 30 pens (6 or 7 pigs/pen; 9 or 7 ft^2/pig). One of the five dietary treatments was randomly assigned to each pen within a block. Average initial body weight was 92.2 lbs for barrows and 90.9 lbs for gilts. Pigs were weighed and feed intake recorded every 3 weeks during the 12-week period to determine ADG and ADFI, from which G:F was calculated. Tenth rib back fat thickness was measured on 3 pigs/pen with an Alkoa 210 ultrasound at week 12. Pigs were marketed after 12 weeks on their respective dietary treatment. Fat depth, loin depth, percent lean, hot carcass weight, and carcass premium were determined at a commercial slaughter facility in Indiana.

Statistical analysis of the data collected was performed using the GLM procedure of SAS. Pigs were blocked by sex and initial body weight. Dietary treatment, sex, and treatment *x* sex interaction were examined to determine their effect on growth and carcass characteristics. Treatment means were also separated using the least significance difference test (LSD) in SAS.

Results and Discussion

Results are summarized in Table 2. Within this study, there were no significant dietary treatment differences in ADG or ADFI at any time period. During weeks 3-6 pigs fed diets B, D, and E had an 8.6% increase in feed efficiency as compared to those fed diets A and C ($P < .03$). For weeks 6-9, diet B had significantly greater feed efficiency than diet A, (.286 vs. .264; $P < .05$). Diet B displayed a 4.5% increase in overall feed efficiency ($P < .05$) when compared to

diets A and C. The dietary treatments did not affect carcass composition for pigs fed NC and NDC (Table 3).

Barrows displayed a greater overall ADG (2.07 vs. 1.93 lbs/day; $P < .0001$) and overall ADFI (6.63 vs. 5.91 lbs/day; $P < .0001$) than gilts. However, gilts had a higher overall G:F ratio than barrows (.329 vs. .313; $P < .014$). Gilts were harvested at the plant with less back fat thickness (.89 vs. 1.03 in; $P < .025$), HCW, but greater percent lean (54.06 vs. 52.96%) and carcass premiums ($5.19 vs. $3.76/cwt) than barrows. Moreover, gilts scanned with less back fat (.69 vs .89 in.; $P < .022$) and loin depth (2.92 vs 3.13 in.; $P < .046$) than barrows.

Pigs fed NDC or NC with additional fat displayed improved feed efficiency at weeks 3-6, 6-9, and overall when compared to those fed NC. The significant improvement in G:F during wk 6-9 and overall for pigs fed diet B compared to diet A may also be related to the higher amino acid content of the diet when NDC is used on a lb for lb substitution for NC. Also, pigs fed NDC with decreased soybean meal and increased synthetic amino acids (diet E) displayed growth rates similar to both diets formulated with NC. These results suggest that, when NDC is fed in the grow-finish period it is comparable to a typical commercial diet of NC with added fat. This improvement in efficiency can be principally attributed to the increased energy concentration of the carbohydrate source, NDC. Additionally, the added amino acids in NDC will allow for greater use of synthetic amino acids in grow-finish diets.

Application

The results of this study suggest that nutridense corn can improve the conversion of feed to product by the grow-finish pig. Current trends are shifting pork producers to be more acutely aware of nutrient utilization and efficiency of their pigs. Nutridense corn provides a carbohydrate source that is more concentrated with energy, protein, and essential amino acids. Therefore, the producer will be able to reduce expensive feed inputs such as soybean meal, fat and lysine. In the future, as producers attempt to maximize efficiency in the grow-finish phase, the use of nutridense corn can play a vital role in improving the gain to feed ratio and reducing feedstuff inputs. However, the costs and yields associated with raising nutridense corn must be compared to the costs and maintenance of fat tanks, associated mixing equipment, protein, and amino acid prices and identity preservation or individual storage of nutridense corn.

Table 1. Example research diet formulations using normal and nutridense corns

	Diets				
Ingredients, %	**A**	**B**	**C**	**D**	**E**
Grow-finish period 1; 90-125 lbs body weight					
Normal Corn	76.16	0.00	0.00	75.39	0.00
Nutridense Corn	0.00	76.16	77.87	0.00	79.25
Soybean meal-48%	20.99	20.99	19.24	21.05	17.79
Lysine-HCL	.15	.15	.15	.15	.20
Vit/Min/Anti	2.62	2.62	2.66	2.63	2.68
Total Nutrient Content					
Fat, %	3.60	4.25	4.27	4.27	4.30
ME, kcal/lb	1503	1516	1516	1517	1515
Lysine	.95	1.0	.95	.95	.95
Threonine	.61	.68	.65	.61	.63
Tryptophan	.18	.19	.18	.18	.17
Methionine	.27	.32	.31	.27	.30
Meth. + Cystine	.57	.66	.64	.57	.63
Valine	.77	.85	.82	.77	.79
Isoleucine	.66	.74	.70	.67	.68
Grow-finish period 4; 240-265 lbs of body weight					
Normal Corn	90.53	0.00	0.00	89.62	0.00
Nutridense Corn	0.00	90.53	92.57	0.00	93.21
Soybean meal-48%	7.33	7.33	5.26	7.41	4.58
Lysine-HCL	.15	.15	.15	.15	.175
Vit/Min/Anti	1.945	1.945	1.975	1.935	1.985
Total Nutrient Content					
Fat, %	3.75	4.52	4.55	4.55	4.56
ME, kcal/lb	1516.5	1531.7	1532.0	1533.5	1532.0
Lysine	.575	.631	.575	.575	.575
Threonine	.40	.48	.45	.39	.44
Tryptophan	.102	.111	.099	.102	.095
Methionine	.203	.261	.252	.200	.250
Meth. + Cystine	.430	.533	.514	.430	.510
Valine	.52	.61	.57	.52	.56
Isoleucine	.41	.50	.46	.41	.45

Table 2. Grow-finish growth performance of pigs fed normal and nutridense corns

	Diet[1]					Std.	Sex		Prob., P=	
Response	**A**	**B**	**C**	**D**	**E**	**Err.**	**Barrows**	**Gilts**	**Trt**	**Sex**
Int. BW, lb	91.6	91.4	91.6	91.6	91.7	.707	92.2	90.87	.999	.044
Wk 0 to 3										
ADG, lb/d	1.95	1.94	1.90	1.84	1.90	.055	1.9	1.88	.661	.214
ADFI, lb/d	4.66	4.80	4.68	4.61	4.63	.107	4.8	4.51	.752	.004
G:F	.421	.408	.408	.402	.412	.011	.40	.417	.761	.184
Wk 3 to 6										
ADG, lb/d	2.20	2.23	2.10	2.26	2.23	.067	2.3	2.14	.498	.053
ADFI, lb/d	6.54	6.11	6.24	6.15	6.18	.171	6.7	5.82	.434	.001
G:F	.338[b]	.366[a]	.336[b]	.366[a]	.366[a]	.009	.34	.369	.035	.002
Wk 6 to 9										
ADG, lb/d	1.90	1.98	1.93	1.94	1.96	.043	2.0	1.86	.721	.001
ADFI, lb/d	7.21	6.95	6.96	7.01	7.10	.167	7.5	6.65	.783	.001
G:F	.264[b]	.286[a]	.279[ab]	.278[ab]	.278[ab]	.006	.27	.280	.227	.201
Wk 9 to 12										
ADG, lb/d	2.01	2.04	1.97	1.95	1.94	.043	2.1	1.89	.428	.001
ADFI, lb/d	7.84	7.64	7.75	7.60	7.60	.152	8.0	7.37	.753	.001
G:F	.256	.269	.255	.257	.256	.006	.26	.257	.432	.605
Overall										
ADG, lb/d	2.01	2.05	1.97	2.00	2.01	.027	2.1	1.94	.386	.001
ADFI, lb/d	6.54	6.38	6.39	6.34	6.37	.117	6.7	6.09	.765	.001
G:F	.308[b]	.322[a]	.310[b]	.316[ab]	.317[ab]	.004	.31	.320	.146	.014
Final BW, lb	260.7	263.7	255.7	259.4	260.5	2.70	266.0	254.0	.372	.001

[1] Diet A = Normal Corn; Diet B = Nutridense corn on a lb for lb substitution of normal corn; Diet C = Nutridense corn formulated to the same lysine level as Diet A; Diet D = Normal corn with supplemental fat to make it isolipid to Diet B; Diet E = Nutridense corn with extra synthetic lysine to replace more SBM and further reduce dietary protein

[a] Mean separation determined by LSD with a level of significance at alpha equal to .05.; No treatment by sex interactions were detected at $P < .10$

Table 3. Grow-finish carcass characteristics of pigs fed normal and nutridense corns at marketing

	Diet[1]					Std.	Sex		Prob., P=	
Diet	**A**	**B**	**C**	**D**	**E**	**Err.**	**Barrows**	**Gilts**	**Trt**	**Sex**
Real-time Ultrasound[a]										
Backfat, in	.82	.74	.74	.88	.78	.022	.89	.69	.151	.002
Loin Depth, in	3.09	2.92	3.00	3.05	3.00	.061	3.13	2.92	.795	.046
Plant Data[b]										
Backfat, in	.99	.96	.94	.97	.95	.029	1.03	.89	.944	.025
Loin Depth, in	2.70	2.71	2.61	2.66	2.66	.024	2.65	2.69	.500	.328
HCW, lb	203.5	200.0	198.0	197.5	201.0	1.02	202.2	197.8	.222	.038
% Lean	53.5	53.7	53.5	53.5	53.5	.242	53.0	54.1	.994	.032
Premium, $/cwt	4.68	4.66	4.29	4.37	4.40	.273	3.76	5.19	.941	.020

[a]Mean values of 3 pigs/pen analyzed as pen means from ultrasound data

[b]Mean values of treatment/sex combinations from plant AUS system for all pigs

[1]Diet A = Normal Corn; Diet B = Nutridense corn on a lb for lb substitution of normal corn; Diet C = Nutridense corn formulated to the same lysine level as Diet A; Diet D = Normal corn with supplemental fat to make it isolipid to Diet B; Diet E = Nutridense corn with extra synthetic lysine to replace more SBM and further reduce dietary protein