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C W. Hastad

Michael D. Tokach

Jim L. Nelssen

See next page for additional authors

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Comparison of yellow dent and nutridense corn hybrids for nursery pig diets

Authors

C W. Hastad, Michael D. Tokach, Jim L. Nelssen, Robert D. Goodband, and Steven S. Dritz

COMPARISON OF YELLOW DENT AND NUTRIDENSE CORN HYBRIDS FOR NURSERY PIG DIETS [1]

C. W. Hastad, M. D. Tokach, J. L. Nelssen, R. D. Goodband, and S. S. Dritz [2]

Summary

A total of 315 nursery pigs (initially 33.5 lb) were used in a 21-d growth assay to compare relative energy values of 'Nutridense' and 'Nutridense Low Phytate' corn compared to Yellow Dent corn. Dietary treatments consisted of a 3 × 3 factorial with three sources of corn with 0, 3, or 6% added fat. Increasing the energy density of the diet with added fat or higher energy corn varieties (Nutridense or Nutridense-LP corn) linearly improved feed efficiency. The linear improvement in feed efficiency allowed us to calculate the energy content of the Nutridense corn varieties relative to Yellow Dent corn. We determined that the ME values published by the University of Illinois indicating that Nutridense and Nutridense Low Phytate corn contain approximately 6.5 and 4% more energy, respectively, than normal Yellow Dent corn are appropriate for diet formulation.

Key Words; Corn, Fat, Energy, Nursery Pigs.)

Introduction

Nutridense corn is a nutritionally enhanced product containing traits to provide greater nutrient density than conventional yellow Dent corn. Specifically, it contains approximately 30% more lysine, 50% more sulfur amino acids, 18% more threonine, almost 100% more tryptophan and 6% more energy than normal corn. Exseed Genetics, LLC also produces a low phytate Nutridense corn (Nutridense-LP) that contains approximately 75% available P compared to about 14% available P for normal corn.

Experiments have been conducted at the University of Illinois to determine the available P content of Nutridense and Nutridense-LP corn and the energy value of these hybrids compared to normal corn. These experiments confirmed the predicted value of most nutrients with the exception of the energy value for the low phytate corn. Nutridense and Nutridense-LP were expected to contain approximately 6 and 9% more energy than normal yellow corn, respectively. The experimental results indicated the advantages were approximately 6.5 and 4%, respectively.

Therefore, this experiment was designed to determine the relative energy density of Nutridense and Nutridense-LP in diets for pigs in the late nursery stage. A second objective was to determine whether higher energy density diets could be achieved using Nutridense corn in conjunction with high levels of added dietary fat.

Procedures

A total of 315 pigs (33.5 lb) were used in a 21-day growth assay. Pigs were blocked by weight and allotted to one of nine treatments. There were five pigs per pen and seven pens per treatment. Pigs were housed in the Kansas State University Segregated Early Weaning facility. Each pen was 4 × 4 ft and contained one self-feeder and one nipple waterer

[1]Appreciation is expressed to Exseed Genetics LLC, for partial financial support for this trial.
[2]Food Animal Health and Management Center.

to provide ad libitum access to feed and water.

The nine diets for the experiment included three corn sources (Yellow Dent corn, Nutridense corn, and Nutridense Low Phytate corn) each with increasing levels of added fat (0, 3, and 6 %). Nutrient values for Nutridense and Nutridense Low Phytate corn were provided by Exseed (Table 1). The energy value for Nutridense and Nutridense-LP corn was calculated at 6 and 9% greater than the value of Yellow Dent corn in diet formulation. Nutrient values for Yellow Dent corn were from N□C (1998). All experimental diets where balanced to maintain a constant lysine to calorie ratio and available phosphorus level (Table 2).

Pigs were weighed and feed disappearance was measured every 7 days to determine ADG, ADFI, and feed efficiency. Data were analy□ed as a randomi□ed complete block design with pen as the experimental unit. After testing for interactions between corn source and fat level, linear and □uadratic polynomial contrasts were used to determine the effects of increasing levels of fat. Single degree of freedom contrasts were used to determine differences among corn sources.

Results and Discussion

□esults from this trial are listed in Tables 3, 4, and 5 with interactive means shown in Table 3, main effects of corn source and fat levels in Table 4, and probabilities of differences in Table 5. There was no corn source by fat level interaction except for ADG from d 14 to 21. This interaction occurred because ADG increased when fat was increased from 0 to 3% for pigs fed Nutridense or Yellow Dent corn; however, ADG decreased as the fat level increased from 0 to 3% for pigs fed Nutridense-LP corn. This interaction did not influence the overall response to corn source or fat level.

There was no difference in ADG, ADFI or F/G among corn sources from d 0 to 7. Increasing the fat level from 0 to 6% decreased (linear, $P<0.01$) ADFI and improved (linear, $P<0.01$; □uadratic, $P<0.03$) F/G. A similar response to increasing fat levels was found for d 7 to 14 and d 14 to 21 with ADFI being reduced and F/G being improved linearly ($P<0.01$). From d 7 to 14, ADFI was lower ($P<0.01$) and F/G was improved ($P<0.02$) for pigs fed Nutridense and Nutridense-LP corn compared with pigs fed Yellow Dent corn. From d 14 to 21, pigs fed Nutridense and Nutridense-LP corn had lower ($P<0.01$) ADFI than pigs fed Yellow Dent corn; however, the only difference in feed efficiency was the improvement ($P<0.03$) for pigs fed Nutridense corn compared to Yellow Dent corn.

Overall, there was no difference ($P>0.11$) among corn sources for ADG. However, ADFI was decreased ($P<0.02$) and F/G was improved ($P<0.05$) for pigs fed Nutridense or Nutridense-LP corn when compared to pigs fed Yellow Dent corn. There were no differences in pig performance when comparing Nutridense and Nutridense-LP corn for any of the response criteria. Increasing fat levels linearly reduced ($P<0.01$) ADFI and improved ($P<0.001$) F/G in every period and for the overall trial.

Analysis of our data indicates that ME was approximately 5 and 3% higher for the two respective Nutridense corn varieties than for Yellow Dent corn. Our results agree with the work from the University of Illinois indicating that Nutridense and Nutridense-LP corn have higher ME content than Yellow Dent corn. Their research determined that ME was increased by 6.5 and 4% for Nutridense and Nutridense-LP corn, respectively, compared with Yellow Dent corn. The small differences between our results and theirs may be because the Yellow Dent corn used in our experiment was higher in energy and, thus, a relatively smaller difference was calculated. Additionally, we used the N□C (1998) value for Yellow Dent corn rather than the analy□ed value used by the University of Illinois. Also, if the energy values from the University of Illinois are used to calculate dietary energy content in a regression e□uation with the actual feed efficiency values of each individual pen, the resultant linear fit is □uite good (r^2 □0.55; $P<0.01$; Figure 1). If the treatment means are used for the regression e□uation instead of

the pen means, the quality of the fit is even better (Figure 2). Our results indicate that the higher ME values determined by the University of Illinois for Nutridense and Nutridense-LP corn compared with Yellow Dent corn are appropriate for diet formulation.

A second goal of our study was to evaluate the ability to achieve higher energy diets with Nutridense corn compared with Yellow Dent corn and added fat. We were able to demonstrate linear improvements in feed efficiency through the highest levels of added fat with all corn varieties. This indicates that higher dietary energy density and further improvements in feed efficiency can be achieved with Nutridense corn and added fat compared with Yellow Dent corn and added fat. A corn soybean meal-based diet with 6% added fat is the maximum limit of added fat to prevent feed handling problems. Thus, the Nutridense corn may provide an option to feed an even higher energy density diet.

Table 1. Composition of Corn Sources

Item	Yellow Dent Corn	Nutridense	Nutridense LP
Dry Matter, %	89	88	88
Oil, %	3.9	4.8	4.8
Protein, %	8.3	10	10
ME, kcal/lb	3420	3625[a]	3728[a]
Fiber, %	2.8	2	2
Calcium, %	0.03	0.01	0.01
Phosphorus (Total), %	0.28	0.32	0.32
Phosphorus (Available), %	14	0.11	0.3
Magnesium, %	0.12	0.13	0.13
Potassium, %	0.33	0.35	0.35
Sulfur, %	0.13	0.11	0.11
Amino acids, %			
Lysine	0.26	0.31	0.31
Arginine	0.37	0.52	0.52
Cystine	0.19	0.23	0.25
Isoleucine	0.28	0.41	0.41
Leucine	0.99	1.35	1.35
Methionine	0.17	0.21	0.24
Tryptophan	0.06	0.07	0.07
Threonine	0.29	0.34	0.38
Valine	0.39	0.55	0.56

[a]Metabolizable energy value for corn was estimated at 6 and 9% greater than the ME of Yellow Dent corn for Nutridense and Nutridense-LP corn, respectively.

Table 2. Composition of Experimental Diets (As-Fed-Basis)

Corn source:	Yellow Dent			Nutridense			Nutridense LP		
Ingredient, lb/ton Fat, %:	0	3	6	0	3	6	0	3	6
Corn source	62.79	57.61	52.46	62.17	57.04	52.02	61.64	56.57	51.55
Soybean meal (46.5%)	33.38	35.55	37.68	34.13	36.24	38.25	35.11	37.12	39.13
Choice white grease	0	3.00	6.00	0	3.00	6.00	0	3.00	6.00
Monocalcium phosphate (21% P)	1.50	1.50	1.50	1.30	1.30	1.30	0.90	0.95	0.95
Limestone	0.95	0.95	0.95	1.05	1.05	1.05	1.00	1.00	1.00
Salt	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35
Vitamin premix	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Trace mineral premix	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
Antibiotic	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Lysine HCl	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
DL-methionine	0.03	0.04	0.06	0	0.02	0.03	0	0.02	0.03
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Calculated Analysis:									
Lysine, %	1.25	1.30	1.35	1.30	1.35	1.40	1.33	1.38	1.42
Isoleucine:lysine ratio, %	69	69	69	76	75	75	76	75	74
Leucine:lysine ratio, %	147	144	140	156	151	147	155	150	146
Methionine:lysine ratio, %	28	29	30	28	28	28	29	29	29
Met & Cys:lysine ratio, %	58	57	58	59	58	58	60	59	59
Threonine:lysine ratio, %	64	63	63	65	64	63	66	66	65
Tryptophan:lysine ratio, %	20	20	20	20	20	20	20	20	20
Valine:lysine ratio, %	80	79	78	86	84	83	86	84	83
ME, kcal/lb	1,486	1,547	1,608	1,546	1,602	1,658	1,581	1,634	1,688
Protein, %	20.9	21.4	22.0	22.1	22.6	23.0	22.5	22.9	23.3
Calcium, %	0.77	0.78	0.78	0.76	0.77	0.77	0.67	0.69	0.69
Phosphorus, %	0.72	0.72	0.72	0.71	0.71	0.70	0.63	0.64	0.63
Available phosphorus, %	0.39	0.39	0.40	0.39	0.39	0.39	0.39	0.39	0.39
Lysine:calorie ratio, g/mcal	3.82	3.82	3.82	3.82	3.82	3.82	3.82	3.82	3.82

Table 3. Means of Source and Level on Growth Performance of Phase III Nursery Pigs[a]

Corn source:	Yellow Dent			Nutridense			Nutridense LP		
Item Fat, %:	0	3	6	0	3	6	0	3	6
D 0 to 7									
ADG, lb	1.35	1.31	1.35	1.27	1.29	1.31	1.34	1.32	1.35
ADFI, lb	2.07	1.99	1.89	1.96	1.98	1.83	2.05	2.01	1.93
F/G	1.54	1.54	1.41	1.54	1.54	1.40	1.53	1.53	1.43
D 7 to 14									
ADG, lb	1.69	1.73	1.74	1.61	1.73	1.71	1.68	1.73	1.67
ADFI, lb	2.81	2.64	2.63	2.63	2.53	2.48	2.60	2.58	2.46
F/G	1.67	1.53	1.52	1.63	1.46	1.45	1.55	1.49	1.48
D 14 to 21									
ADG, lb	1.79	1.99	1.94	1.85	1.92	1.87	1.86	1.80	1.89
ADFI, lb	3.05	3.13	2.96	2.93	2.90	2.84	3.07	2.86	2.79
F/G	1.70	1.57	1.53	1.59	1.52	1.52	1.65	1.60	1.48
Overall									
ADG, lb	1.61	1.67	1.67	1.57	1.65	1.63	1.63	1.62	1.64
ADFI, lb	2.64	2.58	2.49	2.50	2.47	2.38	2.57	2.48	2.40
F/G	1.64	1.54	1.49	1.59	1.50	1.46	1.58	1.54	1.46

[a]A total of 315 pigs (five pigs per pen and seven pens per treatment) with an average initial BW of 33.5 lb.

Table 4. Main Effects of Corn Source and Level of Fat on Growth Performance of Phase III Nursery Pigs[a]

	Corn Source			Fat Level		
Item	Yellow Dent	Nutridense	Nutridense LP	0%	3%	6%
D 0 to 7						
ADG, lb	1.34	1.29	1.34	1.32	1.31	1.34
ADFI, lb	1.98	1.92	2.00	2.03	1.99	1.89
F/G	1.50	1.49	1.50	1.53	1.54	1.42
D 7 to 14						
ADG, lb	1.72	1.69	1.69	1.66	1.73	1.71
ADFI, lb	2.69	2.55	2.54	2.68	2.59	2.52
F/G	1.57	1.52	1.51	1.62	1.49	1.48
D 14 to 21						
ADG, lb	1.91	1.88	1.85	1.83	1.91	1.90
ADFI, lb	3.04	2.89	2.91	3.02	2.96	2.86
F/G	1.61	1.54	1.58	1.65	1.56	1.50
Overall						
ADG, lb	1.65	1.62	1.63	1.60	1.65	1.65
ADFI, lb	2.57	2.45	2.48	2.57	2.51	2.42
F/G	1.56	1.52	1.53	1.60	1.53	1.47

[a]A total of 315 pigs (five pigs per pen and 21 pens per treatment) with an average initial BW of 33.5.

Table 5. Probability of Source and Level of Corn Source and Fat on Growth Performance of Phase III Nursery Pigs[a]

				Corn Source			Fat Level		
Item	Level	Source	Source × Level	Yellow vs. Nutridense	Yellow vs. Nurtidense LP	Nutridense vs. Nutridense LP	Linear	Quad	SE
D 0 to 7									
ADG, lb	0.77	0.51	0.99	0.31	0.99	0.31	0.72	0.54	0.05
ADFI, lb	0.02	0.33	0.92	0.27	0.75	0.16	0.008	0.41	0.06
F/G	0.001	0.95	0.98	0.80	0.99	0.78	0.001	0.03	0.04
D 7 to 14									
ADG, lb	0.15	0.65	0.73	0.38	0.49	0.86	0.19	0.15	0.04
ADFI, lb	0.01	0.007	0.83	0.01	0.01	0.98	0.003	0.70	0.06
F/G	0.001	0.02	0.33	0.02	0.01	0.78	0.001	0.01	0.03
D 14 to 21									
ADG, lb	0.08	0.25	0.04	0.42	0.10	0.39	0.06	0.21	0.04
ADFI, lb	0.01	0.007	0.20	0.004	0.01	0.76	0.004	0.56	0.06
F/G	0.001	0.08	0.25	0.03	0.32	0.20	0.001	0.51	0.03
Overall									
ADG, lb	0.07	0.24	0.55	0.11	0.22	0.69	0.04	0.28	0.03
ADFI, lb	0.001	0.006	0.97	0.002	0.02	0.39	0.001	0.67	0.04
F/G	0.001	0.02	0.53	0.01	0.05	0.43	0.001	0.39	0.02

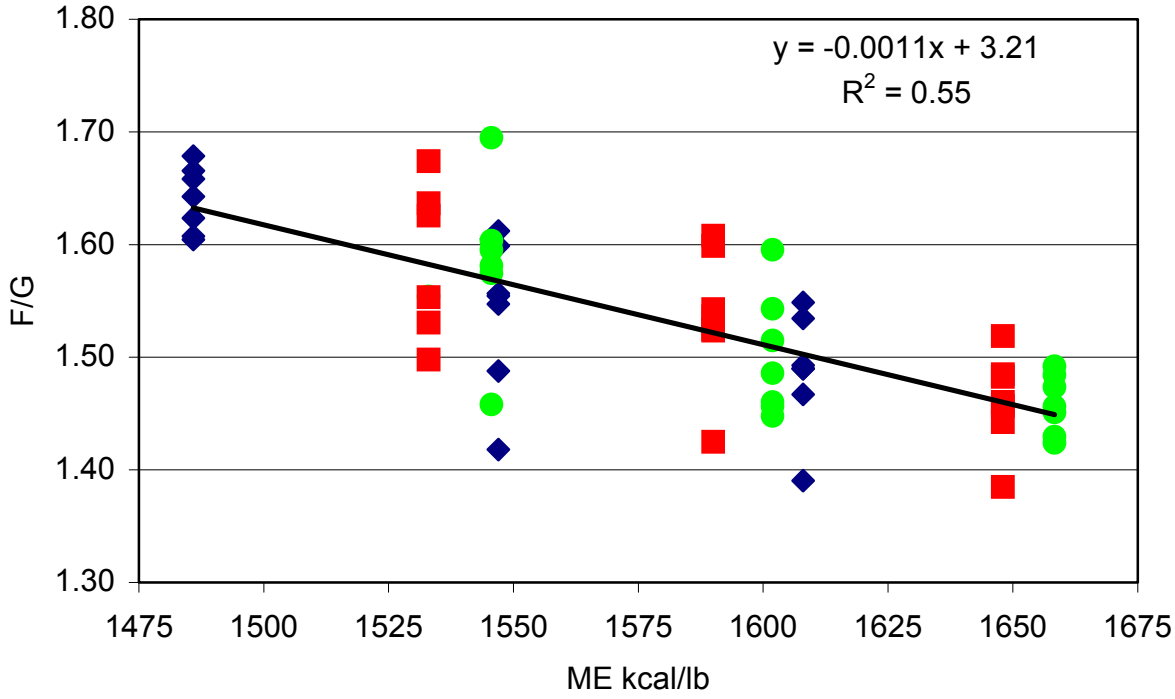

Figure 1. Relationship between dietary energy density for the nine dietary treatments and feed efficiency for the individual pens (♦ Yellow Dent corn; ■ Nutridense-LP corn; and ● Nutridense corn.

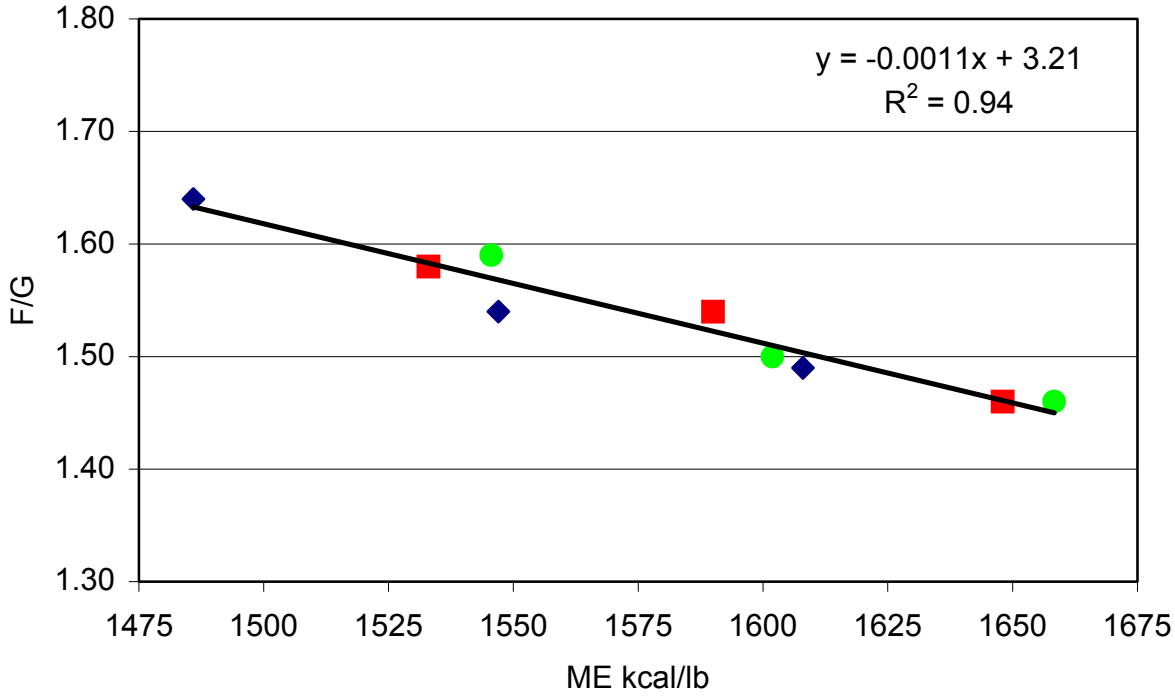

Figure 1. Relationship between dietary energy density for the nine dietary treatments and the treatment means for feed efficiency (♦ Yellow Dent corn; ■ Nutridense-LP corn; and ● Nutridense corn.