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Energy and Nitrogen Utilization of Roundup Ready® Corn (Event nk603) and Non-Transgenic Corn in Young Pigs

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Summary and Implications

This experiment was conducted to compare the nutritional value, measured by digestible and metabolizable energy, and nitrogen digestibility in young pigs fed either Roundup Ready corn (DKC5740) or non-transgenic corn (DKC5738). The experiment used 12 barrows with an initial body weight of 76.3 lb. The pigs were housed in stainless steel metabolism crates and were randomly allotted to one of two corn treatments, either Roundup Ready corn or control corn. The diets were formulated to contain 97.5% of one of the two varieties of corn and 2.5% minerals and vitamins. The duration of the experiment was 14 days, which included a seven-day adaptation period followed by a seven day total fecal and urine collection period. Feed intake was based on initial body weight and pigs had ad libitum access to water. The digestible energy intakes (dry matter basis; 3.74 versus 3.75 Mcal/d) and the energy digestibility, as a percentage of dry matter intake, (86.6 versus 86.9%) were similar (P > 0.60) between the Roundup Ready corn and control corn. The metabolizable energy intakes (dry matter basis; 3.64 versus 3.66 Mcal/d) and the metabolizable energy, as a percentage of dry matter intake, (84.5 versus 84.8%) were similar (P > 0.60) between the Roundup Ready and control corn. The nitrogen balance data indicated no differences (P > 0.40) between the Roundup Ready corn and control corn for nitrogen intake (0.038 versus 0.040 lb/d), nitrogen digested (0.031 versus 0 .032 lb/d), nitrogen retained (0.014 versus 0.014 lb/d), or nitrogen digestibility (80.1 versus 81.3%). The results of this experiment

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indicate that energy and nitrogen utilization is similar between diets containing either the Roundup Ready corn or non-transgenic control corn when fed to young pigs. Thus, this transgenic corn can be fed to young pigs without negatively affecting nitrogen or energy digestibility.

Introduction

Monsanto is developing a second generation Roundup Ready corn containing event nk603 that has been genetically modified to tolerate Roundup (glyphosate) treatment. Researchers have demonstrated Roundup Ready corn containing event nk603 to be equivalent in composition to genetically similar, non-transgenic corn. Two previous swine finishing studies demonstrated that Roundup Ready corn containing event nk603 had similar feeding value to that of control and conventional reference varieties. In support of these findings, the current study was conducted to determine the digestible energy, metabolizable energy, and nitrogen digestibility of Roundup Ready corn line DCK5740 in young pigs.

Procedures

Animals and Treatments

Twelve crossbred [Danbred × (Danbred × Nebraska White Line)] barrows with an average initial body weight of 76.3 lb were used in a completely randomized design. Two diets were formulated to contain 97.5% of one of two varieties of corn (Roundup Ready corn; DCK5740 or non-transgenic control corn; DCK5738) and 2.5% minerals and vitamins (Table 1). Amino acid composition of the two corn lines is documented in Table 2. Diets were formulated such that the test grain was the only source of protein and energy. Diets were fortified with vitamins and minerals to meet or exceed the NRC (1998) requirements for 45-lb pigs. Pigs were housed in stainless steel metabolism crates (4.9 × 1.6 ft) that allowed separate collection of feces and urine. The pigs were housed in an environmentally controlled room and allowed ad libitum access to water through a nipple waterer.

Table 1. Ingredient and chemical composition of diets, as-fed basis.

Item	DKC5740[a]	DKC5738[a]
Ingredient, %		
Corn[b]	97.50	97.50
Dicalcium phosphate	1.25	1.25
Limestone	0.70	0.70
Salt	0.30	0.30
Vitamin premix[c]	0.15	0.15
Trace mineral premix[d]	0.10	0.10
Chemical composition		
Dry matter[e], %	89.14	89.38
Crude protein[e], %	8.86	8.87
Gross energy[e], Mcal/kg	3.84	3.86
Calcium[f], %	0.70	0.70
Phosphorus[f], %	0.60	0.60

[a]DKC5740 – Roundup Ready corn and DKC5738 – control corn.
[b]Amino acid composition of the two corn varieties shown in Table 2.
[c]Supplied per pound of complete feed in grower diets: retinyl acetate, 1,995 IU; cholecalciferol, 200 IU; α-tocopherol acetate, 11 IU; menadione sodium bisulfite, 1.6 mg; riboflavin, 4.0 mg; d-pantothenic acid, 8.0 mg; niacin, 12.0 mg; vitamin B_{12}, 12.0 µg.
[d]Supplied per pound of complete feed in finisher diets: retinyl acetate, 1,500 IU; cholecalciferol, 150 IU; α-tocopherol acetate, 8.2 IU; menadione sodium bisulfite, 1.2 mg; riboflavin, 3.0 mg; d-pantothenic acid, 6.0 mg; niacin, 9.0 mg; vitamin B_{12}, 9.0 µg.
[e]Analyzed values.
[f]Calculated values.

Table 2. Amino acid analysis of individual ingredients, as-fed basis.

	Corn	
Item	DKC5740[a]	DKC5738[a]
Amino acids, %		
Alanine	0.56	0.61
Arginine	0.29	0.29
Aspartic acid	0.50	0.56
Cystine	0.18	0.20
Glutamic acid	1.37	1.53
Glycine	0.30	0.31
Histidine	0.21	0.21
Isoleucine	0.22	0.23
Leucine	0.84	0.93
Lysine	0.23	0.25
Methionine	0.19	0.17
Phenylalanine	0.36	0.37
Serine	0.36	0.40
Threonine	0.29	0.30
Tyrosine	0.27	0.23
Valine	0.31	0.33

[a]DKC5740 – Roundup Ready corn and DKC5738 – control corn.

Data and Sample Collection

Pigs were fed in two equal feedings daily (at 0800 and 1700 hours) in a mash form. The metabolism study consisted of a seven-day adjustment period to facilities and diets followed by a seven-day period of separate but total collection of feces and urine. During the seven-day adjustment period, a daily feed intake equivalent to 3.75% of initial body weight was achieved and

Table 3. Energy and nitrogen balance[a].

Item	DKC5740 [b]	DKC5738 [b]	SEM	P-Value [c]
No. pigs	6	6		
Initial weight, lb	76.12	76.56	1.014	NS
Final weight, lb	82.91	84.23	1.627	NS
Dry matter intake/d, lb	2.42	2.49	0.115	NS
Apparent dry matter digestibility, %	88.40	88.76	0.456	NS
Gross energy intake, Mcal/d	4.74	4.87	0.224	NS
Apparent digestible energy intake, Mcal/d	3.74	3.75	0.023	NS
Apparent digestible energy, % of DM intake	86.69	86.98	0.555	NS
Metabolizable energy intake, Mcal/d	3.64	3.66	0.024	NS
Metabolizable energy, % of DM intake	84.59	84.86	0.548	NS
Apparent digestible energy, Mcal/lb [d]	1.63	1.56	0.098	NS
Metabolizable energy, Mcal/lb [d]	1.59	1.53	0.094	NS
Nitrogen intake, lb/d	0.038	0.040	0.002	NS
Nitrogen digested, lb/d	0.031	0.032	0.001	NS
Nitrogen retained, lb/d	0.014	0.014	0.001	NS
Nitrogen digestibility, %	80.16	81.37	1.106	NS
Nitrogen retention, % of intake	34.92	35.92	1.153	NS
Nitrogen retention, % of absorbed	43.57	44.15	1.316	NS

[a]The pigs were housed in stainless steel metabolism crates and were randomly allotted to one of two corn treatments. The duration of the experiment was 14 days, which included a 7-day adaptation period followed by a 7-day total fecal and urine collection period. Feed intake was based on initial BW (3.75%) and pigs had ad libitum access to water.
[b]DKC5740 – Roundup Ready corn and DKC5738 – control corn.
[c]NS = nonsignificant effect, P > 0.10.
[d]Apparent digestible and metabolizable energy calculated on a 100% corn basis.

maintained throughout the seven-day collection period. Fecal and urine collections started at 0800 hour on day seven and ended at 0800 hour on day 14 of the experimental period. Total feces were collected, weighed, composited for each pig, and stored at 0°F until subsequent analyses. Urine was collected once daily into a plastic bottle containing 25 mL of 6 N HCl. Each morning the urine collection from the previous day was strained through glass wool to remove particulate matter and a 10% aliquot was retained, recorded, composited for each pig, and stored frozen at 0°F.

Statistical Analysis

Data were analyzed as a completely randomized design using PROC MIXED of SAS (1999). The main effect in the statistical model was genetic corn line (DCK5740 and DCK5738). In all analyses crate was the experimental unit.

Results and Discussion

Dry matter percentage, crude protein percentage, and gross energy density of the two corn varieties were similar (Table 1). The digestibility of dry matter was similar between the corn varieties 88.40 and 88.76%; $P > 0.50$; Table 3). Daily gross energy intake on a dry-matter basis was similar between the two corn varieties. The digestible and metabolizable energy intakes (3.74 versus 3.75 Mcal/d; and 3.64 versus 3.66 Mcal/d; respectively) were similar ($P > 0.60$) between corn varieties. Expressed as a percentage of dry matter intake, digestible and metabolizable energy (86.69 versus 86.98% and 84.59 versus 84.86%; respectively) were similar ($P > 0.60$) between the corn varieties. The values calculated in this experiment for dry matter digestibility, digestible energy as a percentage of dry matter intake, and metabolizable energy as a percentage of dry matter intake are similar to previously published values.

Total nitrogen intake was similar ($P > 0.60$) between the corn varieties (Table 3). The amount of nitrogen digested (0.031 and 0.032 lb/d) and retained (0.014 and 0.014 lb/d) were similar ($P > 0.60$) between the corn varieties. Also, nitrogen digestibility (80.16 and 81.37%; $P > 0.40$) was similar between the two corn varieties. The values for nitrogen digestibility of the corn varieties used in this experiment are similar to the values published previously for corn.

In conclusion, results of energy and nitrogen balance with growing pigs demonstrate that the feeding value of Roundup Ready corn (DKC5740) is equivalent to that of the non-transgenic control variety (DKC5738). Therefore, Roundup Ready® corn can be used in swine diets without negatively affecting energy and(or) nitrogen digestibility.

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