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Energy and Nitrogen Utilization of Corn Rootworm Protected Corn (Event MON 863) and Similar Non-Transgenic Corn in Young Pigs

Robert L. Fischer
University of Nebraska-Lincoln

Phillip S. Miller
University of Nebraska-Lincoln, pmiller1@unl.edu

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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 corn rootworm protected test corn (event MON 863, RX740CRW) or a genetically similar non-transgenic control corn (RX740). The experiment used 12 barrows with an initial body weight of 74.5 lb. The pigs were housed individually in stainless steel metabolism crates and were randomly allotted to one of two corn treatments, either corn rootworm protected corn or non-transgenic control corn. Diets were formulated to contain 97.5% of test or control 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. Dry-matter intakes (2.38 versus 2.36 lb/d) and apparent dry matter digestibility (87.78 and 87.71%) were similar (P > 0.10) between the corn rootworm protected corn and non-transgenic control corn, respectively. The apparent digestible energy (1.78 versus 1.79 Mcal/lb) and the apparent metabolizable energy (1.73 versus 1.74 Mcal/lb) were similar (P > 0.10) between the corn rootworm protected corn and non-transgenic corn, respectively. The nitrogen balance data indicated no differences (P > 0.10) between the corn rootworm protected corn and non-transgenic control corn for nitrogen intake (0.04 versus 0.04 lb/d), nitrogen digested (0.03 versus 0.03 lb/d), nitrogen retained (0.01 versus 0.01 lb/d), or nitrogen digestibility (77.30 versus 78.30%), respectively. The results of this experiment indicate that energy and nitrogen utilization are similar between diets containing either the corn rootworm protected 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

Transgenic crops offer producers a variety of agronomic benefits. Crops with microbial Bt formulations contain the Cry (crystalline protein inclusions) insect control proteins. Following the consumption of the Cry proteins, cells in susceptible insects form selective channels in the cell membrane, which allows an influx of water into the cell. The cells swell due to an influx of water which leads to death of susceptible insects. The test event, MON 863, protects against corn rootworm (CRW, *Diabrotica*). A previous swine finishing study demonstrated that corn containing event MON 863 had similar feeding value to that of non-transgenic control and commercial reference hybrids. In support of the previous study, the current study was conducted to determine the digestible energy, metabolizable energy and nitrogen digestibility in young pigs to provide an index of the nutritional value of corn rootworm corn (event MON 863) relative to a non-transgenic control.

Procedures

Animals and Treatments

Twelve crossbred [Danbred × (Danbred × NE White Line)] barrows with an average initial body weight of 74.5 lb were used in a completely randomized design. Two diets were formulated to contain 97.5% of one of two varieties of corn (Corn Rootworm Protected Corn; MON 863 or non-transgenic control corn; RX740) and 2.5% minerals and vitamins (Table 1). The amino acid composition of the two corn varieties is shown 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.

Data and Sample Collection

Pigs were fed in two equal feedings daily (0800 and 1700 h) in a mash form. The metabolism study

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

Item	RX740CRW[a]	RX740[a]
Ingredient, %		
Corn	97.50	97.50
Dicalcium phosphate	1.25	1.25
Limestone	0.70	0.70
Salt	0.30	0.30
Vitamin premix [b]	0.15	0.15
Trace mineral premix [c]	0.10	0.10
Composition, analyzed		
Dry matter, %	89.38	89.19
Crude protein, %	9.41	9.41
Gross energy, Mcal/lb	1.79	1.79

[a]RX740CRW — Corn rootworm protected corn (event MON 863) and RX740 — non-transgenic control corn.
[b]Supplied per kilogram of diet: retinyl acetate, 4,400 IU; cholecalciferol, 440 IU; α-tocopherol acetate, 24 IU; menadione sodium bisulfite, 3.5 mg; riboflavin, 8.8 mg; d-pantothenic acid, 17.6 mg; niacin, 26.4 mg; vitamin B_{12}, 26.4 µg.
[c]Supplied per kilogram of diet: Zn (as ZnO), 128 mg; Fe (as $FeSO_4 \cdot H_2O$),128 mg; Mn (as MnO), 30 mg; Cu (as $CuSO_4 \cdot 5 H_2O$), 11 mg; I (as $Ca(IO_3) \cdot H_2O$), 0.26 mg; Se (as Na_2SeO_3), 0.3 mg.

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

	Corn	
Item	RX740CRW [a]	RX740 [a]
Amino acids, %		
Alanine	0.58	0.60
Arginine	0.43	0.39
Aspartic acid	0.55	0.51
Glutamic acid	1.49	1.51
Glycine	0.30	0.28
Histidine	0.22	0.20
Isoleucine	0.23	0.21
Leucine	0.94	0.96
Lysine	0.23	0.21
Phenylalanine	0.37	0.36
Serine	0.40	0.40
Threonine	0.30	0.27
Tyrosine	0.24	0.23
Valine	0.32	0.29

[a]RX740CRW — Corn rootworm protected corn (event MON 863) and RX740 — non-transgenic control corn.

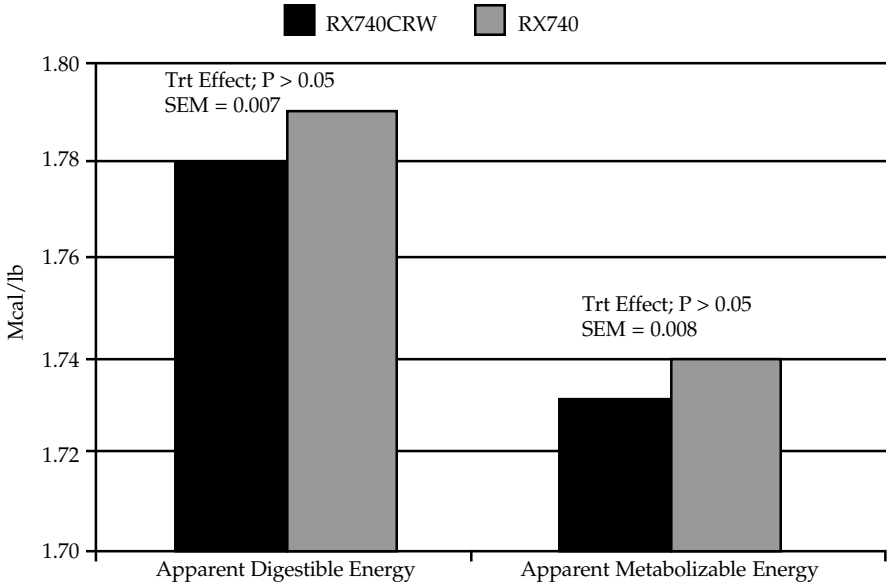

Figure 1. Effect of diet on apparent digestible energy and apparent metabolizable energy; RX740CRW — Corn rootworm protected corn (event MON 863) and RX740 — non-transgenic control corn.

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 maintained throughout the seven-day collection period. Fecal and urine collections started at 0800 hours on day 7 and end at 0800 hours 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, 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 (MON 863 and RX740). 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). Dry matter intake (2.38 versus 2.36 lb/d) and apparent dry matter digestibility (87.78 and 87.71%) were similar (P > 0.10) between the corn rootworm protected corn and non-transgenic control corn (Table 3). The apparent digestible energy (1.78 versus 1.79 Mcal/lb) and the apparent metabolizable energy (1.73 versus 1.74 Mcal/lb) were similar (P > 0.10) between the corn rootworm protected corn and non-transgenic control corn, respectively. The values calculated in this experiment for apparent dry mat-

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ter digestibility, apparent digestible energy and apparent metabolizable energy are similar to the published values of Adeola and Bajjalieh (1997) and NRC (1998).

Total nitrogen intake was similar (P > 0.10) between the corn varieties (Table 3). The amount of nitrogen digested (0.03 and 0.03 lb/d) and retained (0.01 and 0.01 lb/d) were similar (P > 0.10) between the corn rootworm protected and non-transgenic corns, respectively. Likewise, nitrogen digestibility (77.30 and 78.30%; P > 0.10) was similar between corns. The values for nitrogen digestibility of the corn varieties used in this experiment are similar to the values published by Lawrence et al. (1995) and Adeola and Bajjalieh (1997).

In conclusion, results of energy and nitrogen balance with growing pigs demonstrate that the potential feeding value of corn rootworm protected corn (RX740CRW; event MON 863) is equivalent to that of a genetically similar non-transgenic control variety (RX740). Therefore, corn rootworm protected corn can be used in swine diets without negatively affecting energy and/or nitrogen digestibility.

Table 3. Energy and nitrogen balance.

Item	RX740CRW [a]	RX740 [a]	SEM	P-Value
No. pigs	6	6		
Initial weight, lb	74.13	74.97	0.430	0.20
Final weight, lb	80.15	80.26	0.571	0.89
Dry matter intake/d, lb	2.38	2.36	0.057	0.83
Apparent dry matter digestibility, %	87.78	87.71	0.321	0.88
Gross energy, Mcal/lb [bc]	2.05	2.06	—	—
Apparent digestible energy, Mcal/lb [bc]	1.78	1.79	0.007	0.38
Apparent metabolizable energy, Mcal/lb [bc]	1.73	1.74	0.008	0.43
Nitrogen intake, lb/d [c]	0.04	0.04	0.001	0.86
Nitrogen digested, lb/d [c]	0.03	0.03	0.001	0.86
Nitrogen retained, lb/d [c]	0.01	0.01	0.001	0.45
Nitrogen digestibility, %	77.30	78.30	0.733	0.36
Nitrogen retention, % of intake	28.02	31.12	2.530	0.41
Nitrogen retention, % of absorbed	36.22	39.67	3.084	0.45

[a]RX740CRW — Corn rootworm protected corn (event MON 863) and RX740 — non-transgenic control corn.
[b]Calculated on a 100% corn basis.
[c]Calculated on a 100% dry-matter basis.

[1]Robert L. Fischer is a research technologist and graduate student and Phillip S. Miller is a professor in the Department of Animal Science.