Nutritional Value of Corn and Wheat Distillers Grain and Growth Performance

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Summary

Nutritional value of corn, wheat+corn (4:1) and wheat distiller's dried grains with solubles (DDGS) for grower-finisher pigs was evaluated. Corn DDGS had the highest digestible energy (DE) and ileal digestible lysine contents but the digestible phosphorus (P) content was similar among DDGS samples. Following characterisation of its digestible nutrient profile, DDGS still resulted in reductions in growth performance, suggesting that either the reduced average daily feed intake (ADFI) or other nutritional factors for DDGS deserve further investigation to ensure a successful implementation of DDGS in swine diets.

Introduction

DDGS is primarily a by-product from the cereal grain-based ethanol industry. With the growth of the ethanol industry, increasing quantities of DDGS are available for livestock rations. However, the potential of DDGS in swine industry is not fully realized because of the scarcity of information on its nutritional value for swine. In general, DDGS has higher concentrations of nutrients such as protein, fat, vitamins, minerals, and fibre than its parent grain. These nutrients are concentrated due to the removal of most of the cereal starch as ethanol and carbon dioxide during the fermentation process. Wheat and corn DDGS are potential feed ingredients for the swine industry, although DDGS is presently not an important ingredient in western Canada.

"Results indicate that the complex carbohydrate profile appears to be a major constraint to the nutritional value of DDGS "

Experimental Procedure

Digestibility Study: Digestibility and digestible contents of energy, amino acid (AA) and P in DDGS were determined, using 12 barrows fitted with ileal T-cannulae. Pigs were fed a wheat-based control diet or one of three diets with 40% corn, wheat+corn or wheat DDGS in two periods in a controlled cross-over design. Diets were fed twice daily at 2.6 x maintenance.

Table 1. Chemical characteristics of wheat, and corn, wheat + corn, and wheat distiller's dried grains with solubles (% DM)

		Distiller's Dried Grains with Solubles		
Variable	Wheat	Corn	Wheat+corn	Wheat
Moisture	11.8	11.8	8.0	8.1
Crude protein	19.8	30.3	42.4	44.5
Non-protein nitrogen	4.6	5.4	12.4	10.2
Crude fat	1.8	12.8	4.7	2.9
Ash	2.1	4.8	5.0	5.3
Phytate	1.4	0.9	0.6	0.8
Phosphorus	0.5	1.0	1.1	1.2
Acid detergent fibre	2.7	14.6	19.5	21.1
Neutral detergent fibre	9.4	31.2	30.6	30.3
Crude fibre	2.4	7.0	7.8	7.6
Amino acid				
Arginine	0.91	1.33	1.64	1.77
Cysteine	0.48	0.70	0.89	0.96
Histidine	0.46	0.82	0.95	0.99
Isoleucine	0.68	1.14	1.50	1.59
Leucine	1.31	3.52	3.13	3.01
Lysine	0.52	0.83	0.72	0.72
Methionine	0.32	0.61	0.67	0.69
Phenylalanine	0.96	1.51	1.98	2.16
Threonine	0.54	1.09	1.22	1.28
Tryptophan	0.23	0.23	0.37	0.44
Valine	0.84	1.53	1.83	1.91
Total	19.48	28.32	37.25	40.21

Table 2. Apparent ileal and total tract digestible energy (kcal kg^{-1} DM), apparent and standardized ileal digestible lysine (% DM) and total tract digestible phosphorus (% DM) contents in wheat, and corn, wheat + corn, and wheat distiller's dried grains with solubles

	Wheat	Distiller's Dried Grains with Solubles			Pooled
Variable	Control	Corn	Wheat+corn	Wheat	SEM [z]
Energy					
Ileal [y]	3224[b]	3671[a]	3495[ab]	3406[ab]	82.1
Total tract [y]	3807[b]	4292[a]	4038[b]	4019[b]	73.4
Lysine					
Apparent ileal [y]	0.37[c]	0.51[a]	0.45[b]	0.42[b]	0.02
Standardized ileal [y]	0.41[c]	0.55[a]	0.49[b]	0.46[b]	0.02
Phosphorus [y]	0.08[b]	0.47[a]	0.56[a]	0.55[a]	0.04

[z] Standard error of means. [Y] Wheat differs from the three DDGS ($P < 0.05$).
[a-d] Within a row, means without a common letter differ ($P < 0.05$).

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After a 6-d acclimation, faeces was collected for 3 d, and ileal digesta for 2 d.

Performance Study: A total of 100 grower pigs in 20 pens were fed a wheat-pea control diet or one of three diets with 25% corn, wheat+corn or wheat DDGS for 5 wk. Average daily gain (ADG), ADFI, and feed efficiency (G:F) were determined on weekly basis, for a total of five observations per diet.

Results and Discussion

The chemical and nutritional properties varied among the three DDGS samples. Despite the equivalent or higher total nutrient content, nutrient digestibility was lower for the DDGS than the wheat, except for P, which had a digestibility higher for DDGS than wheat. Nevertheless, the digestible contents of nutrients of interest were higher for DDGS than for the wheat. Finally, DDGS inclusion reduced growth performance of pigs, without affecting feed efficiency.

Table 3. Growth performance of pigs fed diets containing wheat, or corn, wheat+corn, and wheat distiller's dried grains with solubles

Variable	Wheat control	Distiller's Dried Grains with Solubles			Pooled SEM
		Corn	Wheat+corn	Wheat	
Body weight (kg)					
d 7	60.19	59.58	59.04	59.45	0.44
d 14	67.01	65.99	65.83	65.78	0.44
d 21	74.33	72.30	72.22	72.33	0.44
d 28	81.31[a]	78.89[ab]	78.77[b]	78.89[ab]	0.44
d 35 [y]	88.06[a]	85.82[ab]	85.39[b]	85.70[ab]	0.44
ADG (kg d $^{-1}$)					
d 0 to 7	1.136	1.056	1.011	1.024	0.03
d 8 to 14	0.982	0.922	0.959	0.920	0.03
d 15 to 21	1.056	0.906	0.899	0.950	0.03
d 22 to 28	1.004	0.950	0.923	0.948	0.03
d 29 to 35	0.972	0.996	0.933	0.990	0.03
d 0 to 35 [y]	1.030[a]	0.966[ab]	0.945[b]	0.967[ab]	0.03
ADFI (kg d $^{-1}$)					
d 0 to 7	2.455	2.294	2.212	2.309	0.05
d 8 to 14	2.723	2.608	2.558	2.475	0.05
d 15 to 21	2.823	2.618	2.676	2.687	0.05
d 22 to 28	2.943[a]	2.802[ab]	2.664[b]	2.863[ab]	0.05
d 29 to 35	2.973	2.880	2.928	2.925	0.05
d 0 to 35 [y]	2.784[a]	2.640[b]	2.607[b]	2.651[b]	0.05
Feed efficiency					
d 0 to 7	0.462	0.460	0.358	0.445	0.01
d 8 to 14	0.362	0.355	0.375	0.377	0.01
d 15 to 21	0.376	0.347	0.335	0.355	0.01
d 22 to 28	0.340	0.341	0.360	0.332	0.01
d 29 to 35	0.328	0.349	0.320	0.342	0.01
d 0 to 35	0.373	0.371	0.370	0.370	0.01

[z] Standard error of means. [y] Wheat differs from the three DDGS ($P < 0.05$). [a-b] Within a row, means without a common letter differ ($P < 0.05$).

Conclusion

Overall, the results of this study indicate that the complex carbohydrate profile appears to be a major constraint to the nutritional value of DDGS for pigs due to its influence on feed intake, retention time, and the digestion of energy and other nutrients. Further, the nutritional value of DDGS might be enhanced by improving the AA balance through supplementation with limiting AA like lysine, in synthetic form and concomitant reduction of high fiber level with supplementary enzymes.

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