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Using Wheat Screenings, Field Peas, and Canola Seed as Replacements for Corn and Soybean Meal in Diets for Growing-Finishing Swine

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Abstract

Two performance experiments were conducted with growing-finishing pigs to determine the effects of adding various levels of wheat screenings to mash-type diets based upon corn and soybean meal when the diets also contained field peas and ground canola seed. Rate of gain was comparable for all treatments containing field peas and ground canola seed (0, 20, 40, or 60% wheat screenings). However, substituting increasing levels of wheat screenings (up to 60% of the diet) increased the feed required per unit of gain (P<.05). Meat color was influenced by diet (P<.01)

Based on data from the study that evaluated nutrient digestibility, the wheat screenings contained 92% of the digestible energy (DE) of corn while the field peas contained 97% of the DE of corn, and the ground canola seed contained 108% of the DE of corn.

Introduction

The increasing number of crop production alternatives provides livestock producers with a greater number of options for energy and protein sources in diets or rations for their livestock. As these alternative feedstuffs become available, it is necessary to have as much information as possible about these feedstuffs as individual ingredients and in combination with other feeds.

Wheat screenings have been available for many years as an alternative energy feed that is usually higher in crude protein than the grains that they replace. Because screenings are expected to contain less energy than the grains that they replace, performance of growing-finishing swine may be reduced unless supplemental energy is added.

Field peas have the potential for replacing a portion of the soybean meal used in swine diets when a source of supplemental methionine is available. Canola seed offers opportunities to provide supplemental energy when wheat screenings are included in swine diets and for providing some supplemental methionine when field peas are incorporated into swine diets.

The experiments reported here were conducted to determine the effectiveness of combinations of wheat screenings, field peas, and canola seed as partial replacements for corn and soybean meal in diets for growing-finishing pigs.

Materials and Methods

General Procedures: Two experiments, one at each location, were conducted with growing-finishing pigs. One hundred-five pigs were utilized at the Dickinson location while 160 pigs were used in the equivalent experiment conducted at Fargo. Average initial and final weights were 44 lb and 258 lb at Dickinson and were 40 and 240 lb, respectively, at Fargo.

Diets used in the growing-finishing experiment were:

1) A pelleted corn-soy reference diet;

2) A corn-soy diet base containing 20% field peas and 7.5% canola seed;

3) A corn-soy diet base containing 20% field peas, 20% screenings, and 15% canola seed;

4) A corn-soy diet base containing 20% field peas, 40% screenings, and 15% canola seed; and

5) A corn-soy diet base containing 20% field peas, 60% screenings, and 15% canola seed.

Diet formulations for the growing phase (40 to 120 pounds) are presented in Table 1. The composition of the diets fed during the development phase (120 to 190 pounds) and the finishing phase (190 pounds to market weight) were similar, but contained lower levels of crude protein, amino acids, calcium, and phosphorus.

Diet 1 was ground, mixed, and pelleted by the Northern Crops Institute at Fargo to serve as an internal control diet between, as well as within, each location. The remaining diets were fed in mash (ground) form and were ground and mixed locally. Single-source samples of wheat screenings, field peas, and canola seed were used for both locations.

The screenings used in these experiments contained 32.82% wheat, 8.72% chaff and straw, 7.84% wild oats, 3.13% wild buckwheat, and 47.49% miscellaneous weed seeds (primarily green and yellow foxtail).

Dietary treatments were randomly assigned to pens within weight replicates and individual pigs were assigned at random to pens within outcome groups based on weight, gender, and ancestry.

Carcass data from pigs in the experiment conducted at Dickinson were obtained from pigs slaughtered at a commercial packinghouse. Carcass information from pigs used in the experiment at Fargo was obtained from pigs processed at the NDSU abattoir.

In addition to the growth experiments conducted at each location, a digestibility experiment was conducted at Fargo to determine the digestibility of selected nutrients in the wheat screenings, field peas, and ground canola samples. Each test ingredient was added as a percentage of the body weight of individual pigs to supplement a basal diet formulated to meet the requirements of growing pigs for all nutrients except energy. Nutrient digestibility was calculated on a dry matter basis. The digestibility of nutrients in the test ingredients was determined by the difference between total excretion of undigested nutrients and the excretion of undigested nutrients provided by the basal diet.

Results and Discussion

Animal performance from the experiment conducted at Dickinson: Combined data (Table 2) for pigs grown to market weight in outdoor facilities revealed that pigs fed the pelleted corn-soy and mash-type corn-pea control diets grew faster (P<.01) than pigs fed diets containing screenings. Pigs fed the pelleted control diet, however, were more efficient than any of the pigs receiving peas and screenings (P<.01). Diets in which peas and canola were fed with 0 to 60% wheat screenings had significant variation. Pigs receiving the corn-pea control diet (mash-type) diet grew faster (P<.01) and were more efficient (P<.001) than pigs fed any of the test levels of wheat screenings. Feed efficiency in the presence of screenings declined linearly as screenings level increased (P<.001).

While feed efficiency declined with increasing level of screenings, only minimal differences were recorded with respect to carcass characteristics. Percent lean, fat depth, and fat-free lean index did not differ. Carcasses from pigs fed the control diets (pelleted or mash) had greater loin depth (P<.10) than those receiving screenings, however fat depth was similar.

Animal performance from the experiment conducted at Fargo: For the complete period of the experiment, pigs receiving the pelleted corn-soy diet gained more rapidly and had lower feed:gain values than pigs fed the ground (mash-type) diets. Within the diets containing field peas and canola but with varying levels of wheat screenings, rate of gain values were not statistically significantly different (P>.05). However, the pigs receiving the diet containing 60% screenings were less efficient than pigs fed the diets containing either 20% screenings or no screenings (P<.05).

There were minimal differences in most carcass measurements (hot or cold carcass weight; carcass length; backfat at the first rib, tenth rib, or last rib; muscle pH, or area of the loin muscle). For backfat depth measured at the last lumbar vertebrae, fat depth increased linearly as percentage of screenings in the diet was increased (P<.05). No explanation for this effect is immediately apparent.

There were no differences in subjective color, firmness, or marbling scores due to dietary treatment (P>.05). However, diet influenced color values determined objectively (Minolta) (P<.01).

Implications

Although economic analysis is in progress, the data from these experiments suggest that combinations of ground wheat screenings, field peas and canola seed can be used effectively by growing-finishing swine. Only modest changes in animal performance were noted and only one of the carcass measurements was influenced by level of screenings in the diet. Diet influenced objective meat color .

Knowledge of the digestibility of major nutrients in the wheat screenings, field peas, and canola seed should assist North Dakota Swine Producers in preparing cost-effective diets to be fed to growing-finishing pigs.

Acknowledgments

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Reference:

Thacker, P.A. and R. N. Kirkwood (Eds.). 1990. Nontraditional Feed Sources for Use in Swine Production. Butterworths.

Table 1. Composition of Experimental Diets for the Growing Phase (40 - 120 pounds).

	Description of Special Dietary Composition:				
	External	Control	20% Screenings	40% Screenings	60% Screenings
	Reference	20% Peas	20% Peas	20% Peas	20% Peas
	(Control)	7.5% Canola	15% Canola	15% Canola	15% Canola
Physical form:	Pelleted	Mash (Meal)	Mash (Meal)	Mash (Meal)	Mash (Meal)
Ingredient (% of diet):	**Diet 1**	**Diet 2**	**Diet 3**	**Diet 4**	**Diet 5**
Corn	69.02	52.55	33.63	20.15	1.66
Wheat screenings	0.00	0.00	20.00	40.00	60.00
Soybean meal, 44%	27.60	16.70	7.93	1.20	0.00
Field peas	0.00	20.00	20.00	20.00	20.00
Ground canola seed	0.00	7.50	15.00	15.00	15.00
L-lysine HCl	0.20	0.12	0.30	0.47	0.45
DL-Methionine	0.10	0.12	0.14	0.17	0.17
L-Threonine	0.03	0.05	0.12	0.20	0.17
L-Tryptophan	0.00	0.01	0.03	0.06	0.05
Dicalcium phosphate	1.45	1.40	1.35	1.20	0.95
Limestone	0.80	0.75	0.70	0.75	0.75

Salt	0.35	0.35	0.35	0.35	0.35
Vitamin & t.m. premix	0.30	0.30	0.30	0.30	0.30
Antibiotic	0.15	0.15	0.15	0.15	0.15
Total	**100.00**	**100.00**	**100.00**	**100.00**	

Table 2. Growing-finishing pig response to increasing levels of wheat screenings in 3-Phase corn-pea diets fed outdoors at the Dickinson Research Extension Center.

Treatments:	Corn/Soy (Pelleted)	Corn/Pea (Mash)	Corn/Pea20% Scrn (Mash)	Corn/Pea40% Scrn (Mash)	Corn/Pea60% Scrn (Mash)	Control vs Pea	Control vs Scrn.	Scrn. vs Linear	SE
Growth:									
Initial Wt., lbs	42.0	42.5	44.0	43.7	47.0				
Final Wt., lbs	259.8	258.8	252.0	256.5	260.8				
Days Fed	106.3	108.6	109.6	115.4	112.4	NS	.009	.046	1.67
Gain/Head, lbs	217.8	216.3	208.0	212.8	213.8	NS	NS	NS	NS
ADG, lbs	2.05	1.99	1.90	1.84	1.90	NS	.004	.085	.039
Feed/Head, lbs	568.8	651.6	673.6	725.1	778.8	.002	.0001	.0001	14.1
Feed/Head/Day, lbs	5.35	6.0	6.15	6.28	6.93	.006	.0001	.0006	.133
Feed:Gain, lbs	2.61	3.01	3.24	3.41	3.64	.003	.0001	.0001	.071

Carcass:									
Slaughter Wt., lbs.	253	250	244	248	253				
Hot Carcass Wt., lbs	180	184	176	179	179	NS	NS	NS	2.87
Percent Yield	71.2	73.4	71.9	72.4	70.9	.043	NS	.055	.477
Percent Lean	53.8	53.9	54.0	53.6	53.9	NS	NS	NS	.60
Fat Depth, in	.69	.73	.68	.70	.69	NS	NS	NS	.033
Loin Depth, in	2.08	2.10	1.99	2.03	1.96	NS	.061	.054	.031
Fat Free Lean Index	49.3	49.0	49.3	49.2	49.4	NS	NS	NS	.394

Table 3. Growing-finishing pig response to increasing levels of wheat screenings in 3-Phase corn-pea diets fed in confinement at Fargo.

Level of screenings:	None	None	20%	40%	60%	
Diet base:	Corn/Soy	Corn/Pea	Corn/Pea	Corn/Pea	Corn/Pea	
Physical form:	Pelleted	Mash	Mash	Mash	Mash	Probability:
Growth:						
ADG, lb.	1.98	1.87	1.84	1.88	1.82	P<0.03
ADFI, lb.	4.89	4.81	4.78	5.01	5.16	N.S.
F/G	2.48	2.58	2.60	2.67	2.84	P<0.01

Carcass:						
Hot carc. wt, lb.	187.4	187.3	191.6	185.9	187.3	N.S.
Cold carc. Wt, lb.	182.3	182.0	186.5	180.7	182.6	N.S.
1st rib fat, in.	1.68	1.74	1.83	1.75	1.75	N.S.
10th rib fat, in.	0.82	0.88	0.92	0.87	0.97	N.S.
Last rib fat	0.95	0.95	1.00	0.96	1.05	N.S.
Muscle pH	5.62	5.61	5.64	5.58	5.61	N.S.
LEA, sq. in.	6.61	6.45	6.75	6.58	6.46	N.S.
Color, subjective	2.00	2.31	2.18	2.06	2.37	N.S.
Firmness	2.37	2.37	2.18	2.25	2.56	N.S.
Marbling	2.00	2.25	2.00	2.06	2.43	N.S.
Color, Minolta L1	58.68	56.62	55.43	56.81	55.06	P<0.01
Color, Hunter 1	51.81	49.56	48.31	49.62	48.00	P<0.01

Table 4. Digestibility of selected nutrients in energy-feeds used in these experiments (Fargo samples).

		Wheat	Ground	
Item:	Corn	Screenings	Field Pea	Canola Seed
Dry matter digestibility, %	87.85	76.54	83.56	65.09
Acid-detergent fiber digestibility, %	68.01	50.31	68.93	56.88

Crude protein digestibility, %	66.77	65.28	72.23	74.73
Digestible energy, kcal/kg	3.701	3.410	3.585	3.987

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