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Abstract
Triticale is a synthetic small grain that results from an intergeneric cross between durum wheat and rye. Triticale has shown potential as a feedstuff in swine diets. Producers who may find this to be an attractive crop may also raise swine in an alternative swine production system. The objective of the present study was to evaluate the effects of triticale-based diets on pork quality and finishing pig performance of pigs reared in deep-bedded hoop barns.

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Animal Science, Agronomy, Food Science and Human Nutrition

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Introduction

Triticale is a synthetic small grain that results from an intergeneric cross between durum wheat and rye. Triticale has shown potential as a feedstuff in swine diets. Producers who may find this to be an attractive crop may also raise swine in an alternative swine production system. The objective of the present study was to evaluate the effects of triticale-based diets on pork quality and finishing pig performance of pigs reared in deep-bedded hoop barns.

Materials and Methods

Animals and Dietary Treatments. Finishing pigs (n=240) fed in hoop barns were used to evaluate the effects of triticale-based diets on pig performance, meat and fat quality, and pork sensory attributes. The study consisted of four trials: two in winter (November 2003 through March 2004) and two in summer (May 2004 through September 2004) at the Iowa State University Western Research and Demonstration Farm, Castana, IA.

Each trial consisted of six pens of ten pigs (five barrows and five gilts) in three small-scale hoop barns (6.0 m × 10.8 m). The pigs were started at 72 kg and fed for 49 days. A two-week adjustment period was allowed. Pens were assigned one of three dietary treatments in meal form: 1) corn-soybean meal control (0% triticale), 2) 40% Trical 815 triticale diet (by weight), or 3) 80% Trical 815 triticale diet (by weight). The 40% and 80% triticale diets had corn and soybean meal added (Table 1). All diets were ground with a hammer mill through a 0.64-cm screen. Animals had ad libitum access to feed and water during the study. At the end of each trial, all pigs were individually scanned with ultrasound for backfat and loin area by a certified technician.

Carcass Measures and Sensory Evaluation. Barrows from one winter and one summer trial were used to evaluate carcass traits, pork quality, and pork sensory attributes. Barrows were transported to Swift and Co., Marshalltown, IA, for processing. After slaughter and chilling, carcass traits were evaluated. Data included carcass composition traits, objective color measurements, and 22 h pH measured at the 10th rib. Subjective firmness of the loin was scored on a scale from 1 to 5, with higher values indicating greater firmness. Loins were evaluated at the ISU Sensory Evaluation Lab. Following a storage period, both the loin and the amount of purge in the bag were weighed to determine the loin-purge percentage. Two chops were removed from the center of the loin and one was used for the evaluation of the chop purge. The other chop was used for determination of marbling (% fat). Two other chops were removed from the center of the loin and broiled. Cooking losses were calculated from weights taken before and after broiling and expressed as a percentage. Instrumental measurement of tenderness of one broiled chop was evaluated using shear force. Sensory evaluation of the remaining broiled chop was performed using a trained professional panel.

Results and Discussion

Triticale Analysis. The Trical 815 triticale in the present study had no detectable mycotoxins. Results of amino acid analysis (Table 2) show Trical 815 triticale had less amino acid content than the NRC values for triticale. However, when compared to the NRC values for amino acid content of corn, Trical 815 triticale had greater contents of all amino acids except leucine. Lysine content was determined to be 42% greater in Trical 815 triticale than in corn (0.37 vs. 0.26%, respectively), according to analysis and NRC values.

Growth Performance. End weights and average daily gain (ADG) (Table 3) were higher during the winter than summer (treatment × seasonal interaction; $P<0.01$) and decreased as triticale inclusion increased ($P<0.001$). No differences in average daily feed intake (ADFI) among treatments were observed. There tended to be more feed consumed during the winter than summer ($P=0.10$). Pigs receiving the control diet had the greatest gain:feed (G:F). Pigs receiving the 80% triticale diet had the least G:F, and those receiving the 40% triticale diet were intermediate. This was observed during both the summer and winter. During the summer, pigs fed the control diet had more backfat (BF) ($P<0.05$) than those fed the 40% or 80% triticale diets. There were no differences in BF during the winter. During the summer, pigs fed the control diet had the largest loin muscle area (LMA) (47.5 ± 1.72 cm^2), pigs fed the 40% triticale diet had intermediate LMA (45.5 ± 1.72 cm^2), and those fed the 80% triticale diet had the smallest LMA (43.4 ± 1.73 cm^2). Three pigs died during the study, one from each dietary treatment.

End weight and ADG of finishing pigs decreased ($P<0.001$) as triticale increased in the diets. However, feed intake was similar among treatments. The 80% triticale diet had 4.8% less metabolizable energy (3160 vs. 3320 kcal/kg) than the control diet, while the 40% triticale diet had 2.4% less metabolizable energy (3240 vs. 3320 kcal/kg) than the control diet. During summer, the pigs fed the 80% triticale diet had 10.1% less ADG than those fed the control diet, whereas during winter, pigs fed the 80% triticale diet had only 3.0% less ADG.

With similar feed intake and lower growth rate, G:F decreased ($P<0.05$) as triticale inclusion increased. Increasing dietary crude fiber 1% may decrease gross energy digestibility by up to 3.5%. Probable consumption of bedding would have further aggravated this situation. Addition of fat or another energy dense dietary ingredient to the triticale diets may have supported similar growth gains and feed efficiency compared to the corn-soybean meal control.

Carcass Measures. There were no differences in carcass weight; BF measured at the 10th rib; and LMA or percentage lean of barrows fed the control, 40%, or 80 % triticale diets (Table 3). Carcasses tended to be lighter with less backfat during the winter than summer ($P<0.10$). Treatment had no effect on loin firmness, loin pH, or loin color. Loin pH was higher during the summer than winter ($P<0.05$).

Meat Quality and Sensory Evaluation. Feeding triticale-based diets to barrows in deep-bedded hoop barns had little effect on meat quality and sensory evaluation of pork during the winter and summer. Differences in tenderness, chewiness, pork flavor, and off-flavor scores were not detected between seasons or among treatments.

Fatty Acid Profile of Loins. Loins from barrows fed triticale-based diets had fatty acid profiles similar to those from barrows fed corn-based diets. Season affected fatty acid profiles of loin chops from barrows in deep-bedded hoop barns. Percentage of total lipids in loins was greater during the summer than winter. This may be because during winter pigs mobilize fat to be used as an energy source for thermoregulation.

Table 1. Composition of diets fed to finishing pigs in deep-bedded hoop barns, as-fed basis.

Ingredient (%)	Control[a]	40% Triticale[a]	80% Triticale[a]
Corn	85.00	46.50	8.50
Triticale	0.00	40.00	80.00
Soybean meal (48% CP)	12.91	11.53	9.64
Dicalcium phosphate	0.60	0.33	0.07
Limestone	0.90	1.05	1.20
Salt	0.34	0.34	0.34
Vitamin premix[b]	0.20	0.20	0.20
Mineral premix[c]	0.05	0.05	0.05
Calculate analysis			
Crude protein (%)	12.90	13.60	14.10
Lysine (%)	0.61	0.62	0.61
Ca (%)	0.53	0.54	0.55
Available P (%)	0.17	0.17	0.17
ME, kcal/kg	3320	3240	3160

[a]Contained 0.5 g/kg aureomycin chlortetracycline (Alpharma Inc., Fort Lee, NJ).
[b]Premix supplied vitamins to meet or exceed NRC (1998) requirements for finishing pigs.
[c]Premix supplied minerals to meet or exceed NRC (1998) requirements for finishing pigs.

Table 2. Amino acid content (percentage) of Trical 815 triticale, triticale and corn, as-fed basis.

Amino acid	Trical 815 triticale[a]	Triticale[b]	Corn[b]
Arginine	0.57	0.57	0.37
Histidine	0.26	0.26	0.23
Isoleucine	0.36	0.39	0.28
Leucine	0.70	0.76	0.99
Lysine	0.37	0.39	0.26
Methionine	0.18	0.20	0.17
Cystine	0.27	0.26	0.19
Phenylalanine	0.49	0.49	0.39
Tyrosine	0.23	0.32	0.25
Threonine	0.32	0.36	0.29
Tryptophan	0.12	0.14	0.06
Valine	0.51	0.51	0.39

[a]Amino acid analyses conducted by University of Missouri Experiment Station Chemical Laboratories, Columbia, MO.
[b]Values from NRC (1998).

Table 3. Performance of finishing pigs fed triticale-based diets in deep-bedded hoop barns during summer and winter[a].

	Summer			Winter		
Item	Control	40%	80%	Control	40%	80%
No. of pigs	40	40	39	39	39	40
No. of pens	4	4	4	4	4	4
Start wt. (kg)	$72.8^{o} \pm 1.87$	$73.1^{o} \pm 1.87$	$70.8^{p} \pm 1.87$	72.3 ± 1.87	72.4 ± 1.87	71.2 ± 1.87
End wt. (kg)	$116.5^{u} \pm 2.17$	$114.5^{v} \pm 2.17$	$110.2^{w} \pm 2.18$	$117.3^{r} \pm 2.18$	$116.3^{s} \pm 2.18$	$115.1^{t} \pm 2.17$
ADG (g/d)	$892^{u} \pm 18$	$846^{v} \pm 18$	$802^{w} \pm 18$	$930^{r} \pm 18$	$901^{s} \pm 18$	$904^{s} \pm 18$
ADFI (kg/d)	3.51 ± 0.18	3.49 ± 0.18	3.53 ± 0.18	3.91 ± 0.18	4.11 ± 0.18	4.35 ± 0.18
Gain:feed (g/kg)	$254^{o} \pm 7$	$243^{op} \pm 7$	$227^{p} \pm 7$	$239^{r} \pm 7$	$221^{rs} \pm 7$	$209^{s} \pm 7$
BF (mm)[b]	$18.3^{o} \pm 0.06$	$17.6^{p} \pm 0.06$	$17.0^{p} \pm 0.06$	17.7 ± 0.06	20.5 ± 0.06	19.6 ± 0.06
LMA (cm^2)[b]	$47.5^{o} \pm 1.72$	$45.5^{op} \pm 1.72$	$43.4^{p} \pm 1.73$	47.6 ± 1.73	44.8 ± 1.73	45.0 ± 1.72

[a]Summer=April through September; Winter=October through March.
[b]From ultrasound scan data.
[opqrst]Within a season, LS means without a common superscript letter differ ($P<0.05$) during summer ([opq]) or during winter ([rst]).
[uvwxyz]Within a season, LS means without a common superscript letter differ ($P<0.01$) during summer ([uvw]) or during winter ([xyz]).