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Abstract

Growth performance, carcass characteristics, and meat quality were evaluated from 320 pigs fed either a control diet or diets containing added creatine monohydrate (CMH). Dietary treatments, initiated 30-d prior to slaughter (192 lb BW), consisted of: 1) a control diet; 2) control diet with 3 g CMH/pig/d for 30 d (maintenance); 3) 25 g CMH/pig/d for 5 d followed by 3 g CMH/pig/d for the next 25 d (early load); 4) or 25 g CMH/pig/d 5 d before slaughter (late load). The results from this experiment suggest that added CMH does not affect finishing pig growth performance but may increase longissimus muscle firmness and decrease drip loss at 14 d postmortem.; Swine Day, Manhattan, KS, November 16, 2000

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EFFECTS OF CREATINE MONOHYDRATE ON FINISHING PIG GROWTH PERFORMANCE, CARCASS CHARACTERISTICS, AND MEAT QUALITY[1]

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Summary

Growth performance, carcass characteristics, and meat quality were evaluated from 320 pigs fed either a control diet or diets containing added creatine monohydrate (CMH). Dietary treatments, initiated 30-d prior to slaughter (192 lb BW), consisted of: 1) a control diet; 2) control diet with 3 g CMH/pig/d for 30 d (maintenance); 3) 25 g CMH/pig/d for 5 d followed by 3 g CMH/pig/d for the next 25 d (early load); 4) or 25 g CMH/pig/d 5 d before slaughter (late load). The results from this experiment suggest that added CMH does not affect finishing pig growth performance but may increase longissimus muscle firmness and decrease drip loss at 14 d postmortem.

(Key Words: Creatine Monohydrate, Carcass Characteristics, Meat Quality.)

Introduction

Creatine is an amino acid derivative normally produced in the liver, kidney, and pancreas from glycine, arginine, and methionine. It increases the bioavailability of phosphocreatine, a molecular component necessary for the production of cellular ATP. Athletes occasionally will take a creatine supplement to enhance duration of peak performance and to reduce fatigue resulting from high-intensity exercise. Creatine supplementation has been shown to result in increased cellular hydration, which is an anabolic proliferative signal for protein synthesis. Pork quality responses observed among limited studies to date with added creatine have been variable. One source of the variation could be the amount and duration of creatine supplementation. Therefore, the objective of this experiment was to evaluate the effects of different levels and durations of creatine monohydrate (CMH) supplementation on finishing pigs' growth performance, carcass characteristics, and meat quality.

Procedures

Three hundred twenty pigs (PIC C22 × L326) were allotted by weight and equalized across treatments for gender and ancestry in a randomized complete block design. There were 10 pigs/pen and eight replicates/treatment. Pigs (initially 118 lb) were housed in a modified-open front building with 50% solid concrete and 50% concrete slat flooring. Each 6-ft × 16-ft pen had a two-hole self-feeder and a nipple waterer to allow ad libitum access to feed and water.

Pigs were fed a nutritionally adequate sorghum-soybean meal diet until 30-d preslaughter (192 lb) when dietary treatments were initiated. Experimental treatments consisted of: 1) a control diet (.65% lysine); 2) control diet with 3 g of CMH/pig/d for 30 d (maintenance); 3) 25 g of CMH/pig/d for 5 d followed by 3 g of CMH/pig/d for the next 25 d (early load); 4) or 25 g of CMH/pig/d 5 d before slaughter (late load).

[1]Appreciation is expressed to Wilke International, Lenexa, KS, for providing the creatine monohydrate.

Weights were obtained on every pig and feed disappearance was recorded on d 30, 25, 15, 10, 5, and prior to slaughter to calculate ADG, ADFI, and feed efficiency (F/G). We measured ADFI prior to the 30-d test period to determine the amount of CMH to be supplemented to provide approximately 25 or 3 g/pig/day in the treatment diets. Two pigs (closest to the average weight of all pigs, 248 lb) per pen were selected and slaughtered at the Kansas State University Meat Laboratory. Blood samples were collected at the time of slaughter to determine serum creatinine levels. Standard carcass measurements; visual analyses of longissimus muscle color, marbling, and firmness; color spectrophotometry (L*, a*, and b*); drip loss; water holding capacity; ultimate pH; and temperature were obtained for each pig at 24 h postmortem. Loins were removed from the right side of each carcass, vacuum packaged, and stored for 14 days at 39°F. Purge loss, drip loss, water-holding capacity, pH, visual analysis, and color spectrophotometry were determined again after the loins were removed from the vacuum bags and allowed 15 min for standardization. Two 1-in-thick chops were obtained from each loin and used for chemical analysis (percentage protein, lipid, moisture) and Warner-Bratzler shear force values.

Chops were cooked to an internal core temperature of 158°F. Thawed and cooked chop weights were obtained to determine percentages of thawing and cooking losses. An Instron Model 5401 compression machine with a v-blade attachment was used to obtain shear force measurements. The v-blade speed during all measurements was 5mm/min. The cores (.5-in. diameter) were taken parallel to the muscle orientation for the tenderness evaluation.

Data were analyzed as a randomized complete block. Pen was the experimental unit for growth performance data, carcass characteristics, and meat quality measurements. The GLM procedure of SAS was used for the contrasts between control vs. creatine, maintenance and early load vs. late load, and maintenance vs. early load. Hot carcass weight was used as a covariate in the statistical model for carcass analysis.

Results and Discussion

Supplementing finishing pig diets with CMH did not affect (P>.15) ADG, ADFI, or F/G during the 30-d treatment period (Table 1). Serum creatinine levels were not different among pigs fed any of the experimental diets.

Dressing percentage, shrink loss (1-(cold carcass wt/hot carcass wt)) × 100, average back fat, tenth rib fat depth, longissimus muscle area, percentage lean, heart weight, and kidney weight (Table 2) were not affected (P>.25) by feeding CMH. Visual color and marbling scores were not affected (P>.20) at 24 h or 14 d postmortem; however, the mean firmness score was greater (P<.05) at 24 h and 14 d for all pigs fed CMH postmortem than for pigs fed the control diet (Table 3 and Table 4). Longissimus muscle percentage moisture, protein, and lipid and 14-d postmortem loin purge loss and Warner-Bratzler shear force values were not affected (P >.21) by dietary treatment. Chop thawing and cooking losses were not different among treatments. Color spectrophotometry, water holding capacity, temperature, and pH at 45 min and 24 h (Table 3) were not affected by feeding CMH. Longissimus muscle drip loss percentage at 24 h postmortem was less (P<.05) for pigs fed maintenance and late load CMH compared to pigs fed early load CMH (4.06 and 4.15 vs. 5.76%). Drip loss also tended to be less (P<.09) for maintenance CMH pigs than for control pigs (4.06 vs. 5.31%). At 14 d postmortem, drip loss was less (P<.06) for pigs fed CMH than for control pigs.

These results suggest that added CMH does not affect finishing-pig growth performance but may increase longissimus muscle firmness and decrease drip loss at 14 d postmortem. That decrease may be associated with increased cellular water retention. Drip loss at 24 h was less for pigs fed maintenance and late load CMH, but pigs fed the early load CMH treatment had greater drip loss and were similar to the control group.

This variability was also evident in comparisons of the water holding capacity of the early load CMH pigs with that of pigs in other treatments. We have no explanation as to why pigs fed the early load CMH treatment were not similar to those in the other CMH treatments. Creatine has been shown to be most beneficial to human athletes actively involved in anaerobic exercise. Therefore, the lack of differences in growth performance was not surprising because pigs are relatively sedentary during late finishing.

Further research needs to be conducted to better understand the effects and mode of action of creatine on pork quality under different conditions. However, if further studies confirm pork quality benefits, such as decreased drip loss and increased muscle firmness, the potential may exist for CMH to be used in the swine industry.

Table 1. Effect of Creatine Monohydrate on Finishing Pig Growth Performance[a,b]

Item	Days before Slaughter	Creatine g/day				SEM
	30-25	0	3	25	0	
	25-5	0	3	3	0	
	5-0	0	3	3	25	
ADG, lb		2.10	2.08	2.09	2.07	.04
ADFI, lb		7.23	7.22	7.17	7.20	.09
F/G		3.45	3.47	3.43	3.48	.05

Table 2. Carcass Characteristics of Finishing Pigs Fed Creatine Monohydrate[a]

Item	Days before Slaughter	Creatine g/day				SEM
	30-25	0	3	25	0	
	25-5	0	3	3	0	
	5-0	0	3	3	25	
Dressing, %		73.76	73.45	72.97	73.31	.29
Shrink loss, %		.42	.44	.39	.40	.06
Cold carcass wt., lb		183.81	180.54	179.41	179.78	1.02
Backfat, in						
First rib		1.54	1.55	1.55	1.57	.03
Tenth rib		.81	.80	.86	.81	.04
Last rib		.92	.88	.86	.90	.03
Last lumbar		.70	.73	.71	.72	.04
Average		1.06	1.05	1.04	1.06	.03
Carcass length, in		32.45	32.75	32.95	32.67	.13
Loin eye area, sq in.		6.39	6.21	6.02	6.29	.12
Lean, %		52.82	52.68	51.75	52.82	.59
Organ wt, lb						
Heart weight		.88	.86	.85	.87	.02
Kidney weight		.81	.84	.77	.81	.02
Serum creatinine, mg/dL		1.90	1.83	1.86	1.89	.03

[a]Hot carcass weight was used as a covariate in the statistical analysis.

Table 3. Carcass Quality Measures of Finishing Pigs Fed Creatine Monohydrate (24 h postmortem)

Days before Slaughter		Creatine g/day				
	30-25	0	3	25	0	
	25-5	0	3	3	0	
Item	5-0	0	3	3	25	SEM
Visual color[a]		2.81	3.00	2.84	2.94	.16
Firmness[a,b]		1.94	2.31	2.00	2.19	.09
Marbling[a]		1.59	1.78	1.66	1.47	.13
L*[c]		57.61	57.37	58.19	55.98	.71
a*[c]		10.01	9.95	10.05	9.81	.27
b*[c]		17.37	16.57	17.34	16.60	.36
a*/b*[c]		.58	.60	.59	.60	.01
Hue angle[c]		59.88	59.13	59.84	59.36	.49
Saturation index[c]		20.08	19.37	20.10	19.33	.42
%R610/%R580[c]		2.29	2.27	2.27	2.30	.03
%R630/%R580[c]		2.69	2.67	2.67	2.72	.05
Drip loss, %[d,e]		5.31	4.06	5.76	4.15	.49
Water holding capacity, %						
24 h postmortem		3.95	3.89	4.02	3.83	.15
14 d postmortem		3.58	3.39	3.38	3.39	.11
Temperature, °C						
45 m postmortem		37.76	37.78	37.98	37.49	.29
24 h postmortem		.98	.64	.83	.80	.24
pH						
45 m postmortem		6.30	6.48	6.36	6.36	.06
24 h postmortem		5.43	5.44	5.41	5.46	.02

[a]Scoring system of 1 to 5: 2 = grayish pink, traces to slight, or soft and watery; 3 = reddish pink, small to modest, or slightly firm and moist; and 4 = purplish red, moderate to slightly abundant, or firm and moderately dry for color, firmness, and marbling, respectively.
[b]Control vs creatine ($P<.05$).
[c]Means were derived from two sample readings per loin. Measures of dark to light (L*), redness (a*), yellowness (b*), red to orange (hue angle), or vividness or intensity (saturation index).
[d]Maintenance and late load CMH vs early load ($P<.05$).
[e]Control vs maintenance ($P<.09$).

Table 4. Carcass Quality Measures of Finishing Pigs Fed Creatine Monohydrate (14-d postmortem)

Item	Days before Slaughter	Creatine g/day				SEM
	30-25	0	3	25	0	
	25-5	0	3	3	0	
	5-0	0	3	3	25	
Visual color		3.00	3.13	3.09	3.09	.14
Firmness[a]		2.06	2.19	2.22	2.31	.08
Marbling		1.88	1.94	1.97	1.78	.12
L*		59.76	58.90	61.01	59.49	.55
a*		10.11	10.38	9.60	10.15	.34
b*		17.57	17.76	17.62	17.66	.31
a*/b*		.57	.58	.54	.57	.01
Hue angle		60.20	59.81	61.50	60.23	.51
Saturation index		20.29	20.60	20.08	20.39	.42
%R610/%R580		2.30	2.36	2.23	2.30	.03
%R630/%R580		2.27	2.33	2.21	2.38	.07
Drip loss, %[b]		1.28	.89	.99	1.12	.12
Loin purge loss, %		3.52	3.72	3.21	3.19	.33
Chop thawing loss, %		5.77	5.52	5.55	5.68	.18
Chop cooking loss, %		25.26	25.11	25.77	25.10	.95
Chop shear force, kg		3.26	3.26	3.13	3.29	.21
Longissimus chemical composition, %						
Crude protein		22.77	23.14	22.81	22.82	.24
Moisture		73.44	73.20	73.20	73.50	.21
Lipid		2.04	2.37	2.41	2.08	.15

[a]Control vs CMH (P<.05).
[b]Control vs CMH (P<.06).