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Effect of narasin (Skycis) or zinc bacitracin (Albac) inclusion on the growth performance and carcass characteristics of finishing pigs sent for slaughter using a 3-phase marketing strategy

J. W. Rickard,*[1] G. L. Allee,† P. J. Rincker,‡ S. L. Gruber,‡ C. L. Puls,‡ and S. N. Carr‡

*Department of Agriculture, Illinois State University, Normal, IL 61790; †Pork Tech, LLC, Columbia, MO 65203; and ‡Elanco Animal Health, Greenfield, IN 46140

ABSTRACT: The objective of this study was to evaluate the effect of dietary inclusion of narasin or zinc bacitracin on the growth performance and carcass characteristics of finishing pigs sent for slaughter using a 3-phase marketing strategy. The study used 2,219 crossbred pigs in a randomized complete block design (blocking factor = start date) with 3 dietary treatments: 1) Control (no feed additive), 2) 15 mg/kg narasin (Skycis, Elanco Animal Health, Greenfield, IN), and 3) 28 mg/kg zinc bacitracin (Albac, Zoetis, Parsippany, NJ). Pigs were housed in single-sex pens of 25 pigs in a commercial wean-to-finish facility and there were 30 pen-replicates of each dietary treatment. All pigs were weighed as a group (i.e., pen) on d 0 (start of experimental feeding period), 77, 91, and 105 (end) of study. Pigs had ad libitum access to feed and water throughout the study period; all feed additions to the feeder were recorded. Pigs were sent for slaughter according to the following marketing strategy: 1) after 77 d on study, the heaviest 20% of each pen was sent for slaughter (Phase 1), 2) after 91 d on study, the next heaviest 48% of each pen were sent for slaughter (Phase 2), and 3) after 105 d on study, the remaining 32% of each pen was sent for slaughter (Phase 3). Pigs within each pen were selected for slaughter by visual appraisal of weight and shipped to a commercial slaughter facility where standard carcass measurements (HCW, LM depth, and backfat depth) were measured. Feeding narasin increased ($P < 0.05$) final live BW (1.3 kg) and overall ADG (1.1%) compared to the other treatments, which were similar ($P > 0.05$). Dietary treatment did not impact ($P > 0.05$) overall G:F. Feeding narasin increased ($P < 0.05$) HCW (1.4 kg) and carcass yield (0.3% units) compared to the other dietary treatments, which were similar ($P > 0.05$) for these traits. Overall, these results demonstrate that narasin-fed pigs had improved overall growth rate, HCW, and carcass yield compared to controls or pigs fed zinc bacitracin.

Key words: carcass, growth, narasin, pig, Skycis, zinc bacitracin

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INTRODUCTION

Ionophores are a separate class of non-medically important antibiotics used only in animal production, which have been used in other industries for a number of years as a means to increase growth rate (Russell and Strobel, 1989; Strauch et. al., 2003; Erickson et al., 2004). One such ionophore, narasin (Skycis, Elanco Animal Health, Greenfield, IN), is approved in the US for increased rate of weight gain and improved feed efficiency in growing-finishing swine (FDA, 2012). The mechanisms behind its mode of action when fed to swine have been previously discussed (Wuethrich et al., 1998; Arkfeld et al., 2015). A number of studies have demonstrated improved growth rate in narasin-fed pigs compared to untreat-

[1]Corresponding Author: jwricka@ilstu.edu
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ed controls, however, many studies were performed in small pens (Arentson and Chewning, 2015; Knauer et al., 2015). In addition, little research has been performed evaluating the growth responses of feeding narasin to those from other common feed additives.

As the swine industry continues to navigate a changing regulatory environment in regards to antibiotic use in feeding programs, it is important to evaluate the effectiveness of ionophore inclusion in swine diets, specifically in a commercial setting. Ionophores may be included in swine diets at an increasing frequency as conventional feed medications are removed.

Many producers send pigs for slaughter using a multiple group marketing strategy (i.e., marketing cuts) to minimize BW and HCW differences of each group of pigs slaughtered. There is limited information on the response of pigs fed narasin in commercial settings, and how this response may differ from smaller pen studies or where conventional feed medication programs were used to increase growth performance. Therefore, the objective of this study was to evaluate the effect of feeding narasin vs. controls and zinc bacitracin on the growth performance and carcass characteristics of finishing pigs sent for slaughter using a 3-phase marketing strategy.

MATERIALS AND METHODS

Experimental procedures in this study were performed in accordance with the Guide for the Care and Use of Agricultural Animals in Agricultural Research and Teaching (FASS, 2010).

Experimental Design and Treatments

The study was performed for a fixed time of 105 d from 44.2 ± 2.59 kg to 133.6 ± 5.51 kg BW using a randomized complete block design (blocking factor was d of start on test) with 3 dietary treatments: 1) Control (no feed additive), 2) 15 mg/kg narasin (Skycis, Elanco Animal Health, Greenfield, IN), and 3) 28 mg/kg zinc bacitracin (Albac, Zoetis, Parsippany, NJ). A total of 2,219 crossbred pigs were housed in 90 single-sex pens. Replicates consisted of 3 single-sex pens (1 per dietary treatment) and there were 30 replicates per dietary treatment. Pen was the experimental unit for all measurements.

Animals and Allotment to Study

Crossbred barrows and gilts that were the progeny of PIC 337 sires × C22 dams (PIC USA, Hendersonville, TN) were used in the study. A total of 90 single-sex pens, each initially housing 25 pigs, were stratified over 2 blocks that were used in the experiment.

Allotment to the study was performed within sex at approximately 91 d of age (44.2 ± 2.59 kg BW). Within sex, pigs were weighed as a group (pen weight) and formed into outcome groups of 3 pens of similar BW, and were randomly allotted from within outcome group to treatment. Following allotment, pigs were moved to their allotted location within the facility and were immediately started on experimental diets.

Housing and Management

Prior to the start of the growth study, pigs were managed according to standard unit protocols and had ad libitum access to diets that were formulated to meet or exceed the nutrient requirements of growing pigs recommended by NRC (2012). Upon arrival to the facility, pigs were placed in pens with the intent that each pen would have approximately the same mean BW and variation in BW.

During the study period, pigs were housed in a tunnel ventilated facility that had fully-slotted concrete floors. Pen dimensions provided a usable floor space of 16.25 m^2, which resulted in 0.65 m^2/pig prior to the first group of pigs being sent for slaughter. Each pen had a 4-space single-sided dry box feeder mounted on the pen division that provided a total of 122 cm of linear feeder space (4.88 cm/pig) and a single cup water drinker.

Diets and Feeding

A 4-phase dietary program was used during the study: Phase 1: fed from 40.8 to 63.5 kg BW, Phase 2: fed from 63.5 to 86.2 kg BW, Phase 3: fed from 86.2 to 104.3 kg BW, and Phase 4: fed from 104.3 kg BW to end of study. Diets were formulated to meet or exceed the nutrient requirements of finishing pigs recommended by NRC (2012). Diet formulations and calculated composition of the diets fed during the experimental period are presented in Table 1 through 4. Pigs had ad libitum access to feed and water throughout the study period.

Growth Study Measurements

All pigs were weighed as a group (i.e., pen) on d 0 (start of experimental feeding period), 77, 91, and 105 (end) of study. All feed additions to the feeders were recorded and feeders were weighed at the time of pig weighing and used to calculate ADFI and G:F.

Marketing Strategy

Pigs were sent for slaughter according to the following marketing strategy: 1) after 77 d on study, the heaviest 20% of each pen (i.e., 5 pigs) was sent for

Table 1. Diet composition, Phase 1, as fed basis (fed from approximately 40 to 63 kg BW)

Item	Dietary treatment		
	Control	Narasin[1]	Zinc bacitracin[2]
Ingredient, %			
Corn	58.23	58.22	58.21
Soybean meal	18.75	18.75	18.75
DDGS[3]	20.00	20.00	20.00
Fat, choice white grease	1.00	1.00	1.00
Limestone	1.28	1.28	1.28
Salt	0.40	0.40	0.40
L-Lysine	0.25	0.25	0.25
Vitamin premix[4]	0.04	0.04	0.04
Trace mineral premix[5]	0.05	0.05	0.05
Phytase[6]	0.01	0.01	0.01
Narasin[1]	-	0.015	-
Zinc bacitracin[2]	-	-	0.025
Total	100	100	100
Calculated composition			
ME, Mcal/lb	1.514	1.514	1.514
CP, %	19.92	19.92	19.92
Total Lys, %	1.09	1.09	1.09
SID[7] Lys, %	0.93	0.93	0.93
Available P, %	0.35	0.35	0.35
Ca, %	0.55	0.55	0.55
SID Met + Cys:Lys	64.59	64.59	64.59
SID Thr:Lys	64.21	64.21	64.21
SID Try:Lys	18.08	18.08	18.08
SID Ile:Lys	71.71	71.71	71.71
SID Val:Lys	84.53	84.53	84.53

[1]Trade name: Skycis (Elanco Animal Health, Greenfield, IN); fed at 13.6 g/ton (15 mg/kg).

[2]Trade name: Albac (Zoetis, Parsippany, NJ); fed at 25 g/ton (28 mg/kg).

[3]DDGS = Distiller's dried grains with solubles.

[4]Provided per kg of final diet: 6,600 IU vitamin A, 704 IU vitamin D_3, 26 IU vitamin E, 4.9 mg riboflavin, 2.6 mg menadione, 0.02 mg vitamin B_{12}, 16.5 mg D-pantothenic acid, and 29.7 mg niacin.

[5]Provided per kg of final diet: 66 mg iron, 66 mg zinc, 19.8 mg manganese, 66 mg copper, 14 mg iodine, and 0.12 mg selenium.

[6]Trade name: OptiPhos 2000 (Huvepharma, Sofia, Bulgaria).

[7]SID = Standardized ileal digestible.

Table 2. Diet composition, Phase 2, as fed basis (fed from approximately 63 to 86 kg BW)

Item	Dietary treatment		
	Control	Narasin[1]	Zinc bacitracin[2]
Ingredient, %			
Corn	61.40	61.38	61.37
Soybean meal	15.75	15.75	15.75
DDGS[3]	20.00	20.00	20.00
Fat, choice white grease	1.00	1.00	1.00
Limestone	1.15	1.15	1.15
Salt	0.40	0.40	0.40
L-Lysine	0.21	0.21	0.21
Vitamin premix[4]	0.04	0.04	0.04
Trace mineral premix[5]	0.05	0.05	0.05
Phytase[6]	0.01	0.01	0.01
Narasin[1]	-	0.015	-
Zinc bacitracin[2]	-	-	0.025
Total	100	100	100
Calculated composition			
ME, Mcal/lb	1.517	1.517	1.517
CP, %	18.73	18.73	18.73
Total Lys, %	0.98	0.98	0.98
SID[7] Lys, %	0.83	0.83	0.83
Available P, %	0.33	0.33	0.33
Ca, %	0.50	0.50	0.50
SID Met + Cys:Lys	69.24	69.24	69.24
SID Thr:Lys	67.24	67.24	67.24
SID Try:Lys	18.40	18.40	18.40
SID Ile:Lys	74.55	74.55	74.55
SID Val:Lys	89.05	89.05	89.05

[1]Trade name: Skycis (Elanco Animal Health, Greenfield, IN); fed at 13.6 g/ton (15 mg/kg).

[2]Trade name: Albac (Zoetis, Parsippany, NJ); fed at 25 g/ton (28 mg/kg).

[3]DDGS = Distiller's dried grains with solubles.

[4]Provided per kg of final diet: 6,600 IU vitamin A, 704 IU vitamin D_3, 26 IU vitamin E, 4.9 mg riboflavin, 2.6 mg menadione, 0.02 mg vitamin B_{12}, 16.5 mg D-pantothenic acid, and 29.7 mg niacin.

[5]Provided per kg of final diet: 66 mg iron, 66 mg zinc, 19.8 mg manganese, 66 mg copper, 14 mg iodine, and 0.12 mg selenium.

[6]Trade name: OptiPhos 2000 (Huvepharma, Sofia, Bulgaria).

[7]SID = Standardized ileal digestible.

slaughter (Phase 1), 2) after 91 d on study, the next heaviest 48% of each pen (i.e., 12 pigs) was sent for slaughter, and 3) after 105 d on study, the remaining 32% of pen (i.e., 8 pigs) sent for slaughter (Table 5). Adjustments were made to the number of pigs removed to account for differences in morbidity and mortality. Pigs within each pen were selected for slaughter by visual appraisal of weight by the production site's normal marketing personnel. On each d that pigs were sent for slaughter (77, 91, and 105), pigs were weighed as a group, and the heaviest pigs were selected and removed from the group, which was weighed again to achieve a start weight for the subsequent marketing phase. The pigs selected for slaughter were weighed as a group, tattooed with a unique pen tattoo, loaded on a conventional semi-trailer, and shipped to a commercial slaughter facility. Descriptions of housing and marketing conditions are presented in Table 5.

Slaughter and Carcass Measurements

Pigs were unloaded and held for at least 1.5 h in lairage with access to water, but not feed. Pigs were slaughtered using standard commercial procedures. Immediately after carcass dressing, HCW was recorded, and backfat and LM depth was measured using the

Table 3. Diet composition, Phase 3, as fed basis (fed from approximately 86 to 104 kg BW)

	Dietary treatment		
Item	Control	Narasin[1]	Zinc bacitracin[2]
Ingredient, %			
Corn	65.14	65.12	65.11
Soybean meal	12.00	12.00	12.00
DDGS[3]	20.00	20.00	20.00
Fat, choice white grease	1.00	1.00	1.00
Limestone	1.18	1.18	1.18
Salt	0.40	0.40	0.40
L-Lysine	0.20	0.20	0.20
Vitamin premix[4]	0.04	0.04	0.04
Trace mineral premix[5]	0.05	0.05	0.05
Narasin[1]	-	0.015	-
Zinc bacitracin[2]	-	-	0.025
Total	100	100	100
Calculated composition			
ME, Mcal/lb	1.517	1.517	1.517
CP, %	17.25	17.25	17.25
Total Lys, %	0.87	0.87	0.87
SID[6] Lys, %	0.73	0.73	0.73
Available P, %	0.28	0.28	0.28
Ca, %	0.50	0.50	0.50
SID Met + Cys:Lys	74.12	74.12	74.12
SID Thr:Lys	69.61	69.61	69.61
SID Try:Lys	18.23	18.23	18.23
SID Ile:Lys	76.37	76.37	76.37
SID Val:Lys	92.99	92.99	92.99

[1]Trade name: Skycis (Elanco Animal Health, Greenfield, IN); fed at 13.6 g/ton (15 mg/kg).

[2]Trade name: Albac (Zoetis, Parsippany, NJ); fed at 25 g/ton (28 mg/kg).

[3]DDGS = Distiller's dried grains with solubles.

[4]Provided per kg of final diet: 6,600 IU vitamin A, 704 IU vitamin D_3, 26 IU vitamin E, 4.9 mg riboflavin, 2.6 mg menadione, 0.02 mg vitamin B_{12}, 16.5 mg D-pantothenic acid, and 29.7 mg niacin.

[5]Provided per kg of final diet: 66 mg iron, 66 mg zinc, 19.8 mg manganese, 66 mg copper, 14 mg iodine, and 0.12 mg selenium.

[6]SID = Standardized ileal digestible.

Table 4. Diet composition, Phase 4, as fed basis (fed from approximately 104 kg BW to end of study)

	Dietary treatment		
Item	Control	Narasin[1]	Zinc bacitracin[2]
Ingredient, %			
Corn	84.48	84.46	84.45
Soybean meal	12.50	12.50	12.50
DDGS[3]	1.00	1.00	1.00
Fat, choice white grease	0.25	0.25	0.25
Monocalcium	1.00	1.00	1.00
Limestone	0.50	0.50	0.50
Salt	0.50	0.50	0.50
L-Lysine	0.16	0.16	0.16
L-Threonine	0.03	0.03	0.03
Vitamin premix[4]	0.04	0.04	0.04
Trace mineral premix[5]	0.05	0.05	0.05
Phytase[6]	0.01	0.01	0.01
Narasin[1]	-	0.015	-
Zinc bacitracin[2]	-	-	0.025
Total	100	100	100
Calculated composition			
ME, Mcal/lb	1.539	1.539	1.539
CP, %	13.11	13.11	13.11
Total Lys, %	0.72	0.72	0.73
SID[7] Lys, %	0.63	0.63	0.63
Available P, %	0.24	0.24	0.24
Ca, %	0.47	0.47	0.47
SID Met + Cys:Lys	67.01	67.01	67.01
SID Thr:Lys	67.37	67.37	67.37
SID Try:Lys	18.27	18.27	18.27
SID Ile:Lys	70.43	70.43	70.43
SID Val:Lys	84.67	84.67	84.67

[1]Trade name: Skycis (Elanco Animal Health, Greenfield, IN); fed at 13.6 g/ton (15 mg/kg).

[2]Trade name: Albac (Zoetis, Parsippany, NJ); fed at 25 g/ton (28 mg/kg).

[3]DDGS = Distiller's dried grains with solubles.

[4]Provided per kg of final diet: 6,600 IU vitamin A, 704 IU vitamin D_3, 26 IU vitamin E, 4.9 mg riboflavin, 2.6 mg menadione, 0.02 mg vitamin B_{12}, 16.5 mg D-pantothenic acid, and 29.7 mg niacin.

[5]Provided per kg of final diet: 66 mg iron, 66 mg zinc, 19.8 mg manganese, 66 mg copper, 14 mg iodine, and 0.12 mg selenium.

[6]Trade name: OptiPhos 2000 (Huvepharma, Sofia, Bulgaria).

[7]SID = Standardized ileal digestible.

Animal Ultrasound Services Carcass Value Technology System (Animal Ultrasound Services Inc., Ithaca, NY). Predicted lean content was calculated using a plant-proprietary equation containing these measurements. Backfat depth for pigs sent for slaughter on d 77 of study was not recorded due to an error in the measuring device.

Statistical Analysis

All variables were analyzed using PROC MIXED of SAS (SAS Inst. Inc., Cary, NC). The pen of pigs was the experimental unit for all measurements. The model included the fixed effect of dietary treatment and random effects of block and replicate nested within block. Sex was not included in the model but was accounted for as single-sex replicates were used in the study. Least-squares means were separated using the PDIFF option of SAS with means being considered different at a $P \leq 0.05$.

RESULTS AND DISCUSSION

Growth Performance

Pigs fed narasin were heavier ($P < 0.05$) at the end of test than controls (1.3 kg) and pigs fed zinc baci-

Table 5. Summary of housing conditions and marketing strategy of pigs sent for slaughter in a 3-phase marketing strategy

Item	Housing conditions
Phase 1 (d 0 to 77)	
No. pigs/pen on d 0	25
Feeder space, cm/pig	4.88
Floor space, m^2/pig	0.65
Approximate % of pigs sent for slaughter/pen	20
No. pigs remaining/pen on d 77	20
Phase 2 (d 77 to 91)	
No. pigs/pen on d 77	20
Feeder space, cm/pig	6.10
Floor space, m^2/pig	0.81
Approximate % of pigs sent for slaughter/pen	48
No. pigs remaining/pen on d 91	8
Phase 3 (d 91 to 105)	
No. pigs/pen on d 91	8
Feeder space, cm/pig	15.25
Floor space, m^2/pig	2.03
Approximate % of pigs sent for slaughter/pen	32

tracin (1.3 kg), which were similar ($P > 0.05$) for this trait (Table 6). For the overall study period, feeding narasin improved ($P < 0.05$) ADG compared to both controls and pigs fed zinc bacitracin (1.1% and 1.1%, respectively). Overall ADFI was greater ($P < 0.05$) for narasin-fed pigs compared to those fed zinc bacitracin (1.8%), with controls being intermediate and not different than either treatment. Dietary treatment did not impact ($P > 0.05$) overall G:F (Table 6).

At the end of Phase 1, pigs fed narasin were heavier ($P < 0.05$) than controls (1.2 kg) and pigs fed zinc bacitracin (1.8 kg) and had greater ($P < 0.05$) ADG during Phase 1 of study than pigs fed zinc bacitracin (2.1%), with controls being intermediate and not different ($P > 0.05$) than either treatment. Zinc bacitracin-fed pigs had lower ($P < 0.05$) ADFI (~1.8% lower) during Phase 1 than the other treatments, which were similar (Table 6). No differences ($P > 0.05$) in G:F were observed between treatments.

During Phases 2 and 3 of the study, dietary treatment did not affect ($P > 0.05$) ADG, ADFI, or G:F.

These results generally agree with previous research. In a meta-analysis, Arentson et al. (2014) reported a 1.55% greater growth rate in narasin-fed pigs compared to controls. These findings have been supported in more recent research as well (Arentson et al., 2016; Knauer et al., 2015; Knauer and Arentson, 2017). Interestingly, these studies fed narasin for shorter durations than in the current study and reported improvements of 3.5 to 4.7%, which suggests that the improvement in growth rate may be dependent on feeding duration. In the present study, there were no differences in feed intake between controls and narasin-fed pigs, results which agree with previous research (Arentson et al., 2013; Arentson and Chewning 2015; Arkfeld et al., 2015). In contrast, studies performed by Arentson et al. (2016) and Knauer and Arentson (2017) reported greater feed intake for narasin-fed pigs compared to controls, but these studies again fed narasin for shorter durations than in the current study. In the current study, feeding narasin or zinc bacitracin did not improve feed efficiency compared to controls, which is in contrast to most previous research. Many studies (Arentson et al., 2013; Arentson and Chewning 2015; Knauer and Arentson, 2017) have reported greater G:F in narasin-fed pigs compared to controls, with ranges from 1.2% (Arkfeld et al., 2015) to 2.5% (Arentson and Chewning, 2016). There is no clear explanation as to why the results of the present study conflict with previous research.

There has been very limited research evaluating effects of zinc bacitracin on pig growth performance, but results from the present study are generally in line with expectations (Moeser et al., 2014). To the authors' knowledge, this is the first study to compare the performance of pigs fed narasin to pigs fed zinc bacitracin.

Carcass Characteristics

Pigs fed narasin were heavier ($P < 0.05$) at the end of test than controls (1.3 kg) and pigs fed zinc bacitracin (1.3 kg), which were similar in this regard (Table 7). In addition, pigs fed narasin had greater ($P < 0.05$) HCW than controls (1.5 kg) and zinc bacitracin-fed pigs (1.3 kg). Carcass yield was greater ($P < 0.05$) for narasin-fed pigs compared to controls and those fed zinc bacitracin (0.4 and 0.3% units, respectively). Dietary treatment did not impact ($P > 0.05$) predicted lean content, LM depth, or backfat depth (Table 7).

Only a limited number of differences were observed between treatments for the different slaughter groups. At the end of Phase 1, pigs fed narasin were heavier ($P < 0.05$) and had greater ($P < 0.05$) HCW than the other treatments. In addition, at the end of Phase 2, pigs fed narasin had greater ($P < 0.05$) carcass yield than controls and pigs fed zinc bacitracin. No other differences ($P > 0.05$) were observed (Table 7).

There has been limited research evaluating carcass characteristics of pigs fed narasin or zinc bacitracin to that of controls. In the present study, pigs fed narasin had greater carcass weight and yield than controls, which is generally in line with previous research. For example, Arentson et al. (2014), in a 4-study meta-analysis, reported 1.05 kg greater carcass weight for narasin-fed pigs compared to controls. Similar results

Table 6. Effects of narasin[1] or zinc bacitracin[2] on the growth performance of finishing pigs sent for slaughter using a 3-phase marketing strategy

	Dietary treatment				
Item	Control	Narasin[1]	Zinc bacitracin[2]	SEM	*P*-value
No. of pens	30	30	30	-	-
Phase 1 (d 0 to 77)[3]					
No. pigs/pen	25	25	25	-	-
BW, kg					
d 0 (start)	44.0	44.2	43.9	1.09	0.60
d 77	118.3^{b}	119.5^{a}	117.7^{b}	0.48	0.01
ADG, kg	0.96^{ab}	0.97^{a}	0.95^{b}	0.020	0.01
ADFI, kg	2.72^{a}	2.74^{a}	2.68^{b}	0.018	0.01
G:F	0.354	0.355	0.355	0.0051	0.54
Phase 2 (d 77 to 91)[4]					
No. pigs/pen	20	20	20	-	-
BW, kg					
d 77	116.4^{ab}	117.5^{a}	115.9^{b}	0.55	0.04
d 91	128.9	130.3	129.0	0.63	0.07
ADG, kg	0.86	0.90	0.91	0.016	0.47
ADFI, kg	3.05	3.10	3.05	0.077	0.30
G:F	0.293	0.292	0.301	0.0048	0.14
Phase 3 (d 91 to 105)[5]					
No. pigs/pen	8	8	8	-	-
BW, kg					
d 91	122.2	124.6	123.0	0.96	0.13
d 105	134.0	136.0	135.1	2.73	0.24
ADG, kg	0.78	0.80	0.81	0.127	0.57
ADFI, kg	3.16	3.27	3.22	0.091	0.14
G:F	0.245	0.244	0.250	0.0332	0.63
Overall (d 0 to end of test)					
BW, kg					
d 0 (start)	44.0	44.2	43.9	1.09	0.60
End of test	133.0^{b}	134.3^{a}	133.0^{b}	1.06	0.03
ADG, kg	0.94^{b}	0.95^{a}	0.94^{b}	0.024	0.04
ADFI, kg	2.78^{ab}	2.81^{a}	2.76^{b}	0.028	0.01
G:F	0.339	0.340	0.342	0.0053	0.18

^{a,b}Means within a row with different superscripts are different ($P < 0.05$).

[1]Trade name: Skycis, Elanco Animal Health, Greenfield, IN.

[2]Trade name: Albac, Zoetis, Parsippany, NJ.

[3]Heaviest ~20% of pigs sent for slaughter on d 77.

[4]Next heaviest 48% of pigs sent for slaughter on d 91.

[5]Final 32% of pigs sent for slaughter on d 105.

have been observed in other studies (Arentson and Chewning, 2015; Knauer et al., 2015). Although limited, previous research has shown increased carcass yield in narasin-fed pigs compared to controls (Knauer et al., 2015; Arentson and Chewning, 2016), results similar to the current study. In contrast, Arkfeld et al. (2015) reported no difference between controls and pigs fed narasin for carcass weight or yield. That study also reported no difference in LM depth or backfat depth, results similar to the current study.

To the authors' knowledge, there is no published research to show effects of zinc bacitracin on carcass characteristics of finishing pigs, thus, comparing the effects observed in the current study to expectations proved difficult.

Collectively, the results of this study suggest that feeding narasin increases growth rate in growing-finishing pigs, but additional carcass weight and yield may provide additional benefit. Furthermore, the results observed in this study, performed in a commercial setting, were similar to those observed in previous smaller pen studies. However, there is still relatively limited published research evaluating narasin in a commercial setting, and further research is warranted.

Table 7. Effects of narasin[1] or zinc bacitracin[2] on the carcass characteristics of finishing pigs sent for slaughter using a 3-phase marketing strategy

Item	Dietary treatment			SEM	*P*-value
	Control	Narasin[1]	Zinc bacitracin[2]		
No. of pens	30	30	30	-	-
Phase 1 (d 77)[3]					
End of test live weight, kg	129.3[b]	131.3[a]	128.6[b]	0.83	0.02
HCW, kg	98.0[b]	99.8[a]	97.1[b]	0.89	0.004
Carcass yield, %	75.8	76.0	75.7	0.21	0.25
Predicted lean content, %	56.6	56.9	56.7	0.18	0.58
LM depth, mm	77.4	78.9	77.1	0.59	0.11
Backfat depth, mm	-	-	-	-	-
Phase 2 (d 91)[4]					
End of test live weight, kg	133.4	134.1	133.1	0.65	0.32
HCW, kg	101.1	102.2	101.1	0.62	0.07
Carcass yield, %	75.8[b]	76.2[a]	75.9[b]	0.13	0.01
Predicted lean content, %	56.9	56.9	57.0	0.13	0.55
LM depth, mm	78.9	79.4	79.4	0.37	0.38
Backfat depth, mm	18.4	18.7	18.3	0.31	0.39
Phase 3 (d 105)[5]					
End of test live weight, kg	134.0	136.0	135.1	2.73	0.24
HCW, kg	101.4	103.3	102.4	1.71	0.16
Carcass yield, %	75.6	76.0	75.8	0.27	0.22
Predicted lean content, %	56.9	56.7	56.7	0.19	0.60
LM depth, mm	78.5	78.2	77.7	0.36	0.42
Backfat depth, mm	18.3	18.7	18.4	0.64	0.69
Overall					
End of test live weight, kg	133.0[b]	134.3[a]	133.0[b]	1.06	0.03
HCW, kg	100.7[b]	102.2[a]	100.9[b]	0.71	0.003
Carcass yield, %	75.7[b]	76.1[a]	75.8[b]	0.10	0.01
Predicted lean content, %	57.0	56.9	57.0	0.05	0.86
LM depth, mm	78.6	78.9	78.5	0.22	0.41
Backfat depth, mm	18.1	18.5	18.1	0.19	0.22

[a,b]Means within a row with different superscripts are different ($P < 0.05$).

[1]Trade name: Skycis, Elanco Animal Health, Greenfield, IN.

[2]Trade name: Albac, Zoetis, Parsippany, NJ.

[3]Heaviest ~20% of pigs sent for slaughter on d 77.

[4]Next heaviest 48% of pigs sent for slaughter on d 91.

[5]Final 32% of pigs sent for slaughter on d 105.

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