EFFECTS OF DIETARY SUPPLEMENTATION OF ORGANIC TRACE MINERALS ON GROWTH PERFORMANCE OF NURSERY PIGS

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ABSTRACT

The experiment was conducted to evaluate the effects of dietary supplementation of organic trace minerals (Availa-Starter 123®) on growth performance of nursery pigs. One hundred and eighty crossbred weaned pigs [(Yorkshire-Landrace) x Duroc; 28 d old; 7.45 ± 0.90 kg of BW] were randomly allotted to 2 treatments in a randomized complete block design. The 2 experimental treatments included (1) basal diet with inorganic trace minerals (Control) and (2) As 1 + 0.175% Availa-Starter 123. Pigs were blocked by their initial body weight. Sex and ancestry were equally distributed across treatments. There were 15 pigs/pen and 6 replicate pens/treatment. The ADG of pigs fed the Availa-Starter 123-supplemented diet (368.2 g) was greater than (P = 0.021) that of pigs fed the control diet (345.3 g) during the experimental period. The Availa-Starter 123 increased (P = 0.020) the final BW of pigs (18.14 kg/pig) when compared with the control (17.55 kg/pig). The diet supplemented with Availa-Starter 123 did not affect ADFI and F:G of pigs as compared with the control (P > 0.05). No differences in the mortality, incidence of diarrhea, and number of antibiotic treatments between the two treatments were found (P > 0.05). Briefly, addition of Availa-Starter 123 to a commercial nursery diet containing inorganic trace minerals improved the growth performance of pigs as it increased the ADG and final BW of pigs.

Keywords: *growth performance, nursery pigs, organic trace minerals*

TÓM TẮT

Thí nghiệm (TN) được tiến hành nhằm đánh giá ảnh hưởng của việc bổ sung khoáng hữu cơ (Availa-Starter 123®) vào thức ăn (TA) đến khả năng sinh trưởng của heo sau cai sữa. Tổng số 180 heo cai sữa lai [(Yorkshire-Landrace) x Duroc; 28 ngày tuổi; khối lượng bắt đầu TN: 7,45 ± 0,90 kg] được bố trí ngẫu nhiên vào 2 nghiệm thức theo kiểu khối hoàn toàn ngẫu nhiên 1 yếu tố. Hai nghiệm thức TA gồm (1) TA cơ bản có khoáng vô cơ (Đối chứng-ĐC) và (2) ĐC + 0,175% Availa-Starter 123. Heo được phân khối dựa vào khối lượng cơ thể lúc bắt đầu TN. Heo giữa các nghiệm thức đồng đều về giới tính và nguồn gốc ổ đẻ. Mỗi nghiệm thức có 6 ô chuồng và mỗi ô chuồng có 15 con heo. Tăng trọng hàng ngày của heo ăn TA có Availa-Starter 123 (368,2 g) cao hơn (P = 0,021) tăng trọng hàng ngày của heo ăn TA ĐC (345,3 g) trong thời gian TN. Availa-Starter 123 đã làm tăng khối lượng cơ thể heo lúc kết thúc TN (18,14 kg/con) khi so với ĐC (17,55 kg/con). Thức ăn có bổ sung Availa-Starter 123 đã không ảnh hưởng đến tiêu thụ TA hàng ngày và hiệu quả sử dụng TA của heo khi so với ĐC (P > 0,05). Không thấy có sự khác biệt về tỷ lệ chết, tỷ lệ tiêu chảy và số lần điều trị kháng sinh giữa 2 nghiệm thức (P > 0,05). Tóm lại, bổ sung Availa-Starter 123 vào TA thương mại có chứa khoáng vô cơ cho heo cai sữa đã cải thiện khả năng sinh trưởng của heo vì nó đã cải thiện tăng trọng hàng ngày và khối lượng cơ thể của heo khi kết thúc TN.

Từ khoá: *heo cai sữa, khả năng sinh trưởng, khoáng hữu cơ*

INTRODUCTION

Microminerals, especially Zn, Cu, Mn and Fe, are essential nutrients for maintenance and production of animals. As common diets contain a very little amount of those minerals to cover the young pigs' requirements for optimal productivity, dietary supplementation of those trace elements for fast-growing piglets are

necessary. Thomaz et al. (2015) reported that trace mineral supplementation, regardless of level and source, improved the performance of piglets. In recent years, organic trace element sources are considered for use as alternatives to inorganic forms due to their greater absorption. From an environmental standpoint, this would be beneficial as lower levels of trace elements are excreted in feces. However, there are variations in the bioavailability of trace mineral sources used in piglet diets. For instance, Schlegel et al. (2013) showed that the bioavailability of organic to inorganic Zn forms ranged from 85 to 117% depending on the stability of the organic sources. Indeed, inconsistent effects of organic trace elements on growth performance of nursery pigs as compared with inorganic forms have been reported (Carlson et al., 2004; Mello et al., 2012; Thomaz et al., 2015).

In Vietnam, data on the use of organic trace element sources in a commercial diet containing inorganic minerals are limited. Different organic trace element sources may have different effects on pig performance and health, especially under commercial pork production in Vietnam. Thus, the objective of this study was to evaluate the effects of dietary supplementation of organic trace minerals (Availa-Starter 123®) on growth performance of nursery pigs.

MATERIALS AND METHODS

Experimental Design, Animals, and Housing

One hundred and eighty crossbred weaned pigs [(Yorkshire-Landrace) x Duroc; 28 days old; 7.45 ± 0.90 kg of BW] were randomly allotted to 2 treatments in a randomized complete block design. Pigs were blocked by their initial body weight. Sex and ancestry were equally distributed across treatments. The 2 experimental treatments included (1) basal diet with inorganic trace mineral premix (Control) and (2) As 1 + 0.175% Availa-Starter 123. Each pen within a block had the same number of gilts and barrows. There were 15 pigs/pen and 6 replicate pens/treatment. Pigs were housed in an open-sided building. Each pen measured 2.0 m x 3.0 m in size with slatted floor and had one nipple waterer.

Experimental Diets and Animal Feeding

The basal diet was formulated to meet or exceed the nutritional requirements of pigs during the experimental period (NRC, 1998). The treatment diet was obtained by supplementing the basal diet with 0.175% Availa-Starter 123 at the expense of corn. The Availa-Starter 123 contained 2.28% Zn, 0.57% Mn, 2.85% Cu, and 2.28% Fe (provided by Zinpro Animal Nutrition Inc., Thailand). The ingredient composition of the experimental diets is presented in Table 1. The analyzed chemical composition of the basal diet is presented in Table 2. Pigs were fed a 1-phase feeding program (28-56 day old). Diets were in meal form. Pigs were fed ad libitum and had free access to water at all times.

Table 1. Ingredient composition of the experimental diets (as-fed basis)

Ingredients, g/kg	Diets	
	Control	Availa-Starter 123
Corn, ground	100.00	98.25
Broken rice	439.00	439.00
Soybean, full fat	176.00	176.00
Soybean meal, 46%	140.00	140.00
Fish meal, 60%	20.00	20.00
Vegetable oil	15.00	15.00
Nuklospray S20-20	50.00	50.00
Bergafat	3.00	3.00
Mineral premix	6.00	6.00

Ingredients, g/kg	Diets	
	Control	Availa-Starter 123
Vitamin premix	2.50	2.50
Limestone	14.40	14.40
MCP	16.40	16.40
Salt	2.80	2.80
L-Lysine	3.60	3.60
DL-Methionine	1.90	1.90
L-Threonine	1.90	1.90
Availa-Starter 123[1]	0.00	1.75
Other additives[2]	7.50	7.50

[1]The product contained 2.28% Zn, 0.57% Mn, 2.85% Cu, and 2.28% Fe (Zinpro Animal Nutrition Inc., Thailand).

[2]Other additives: ProAct, organic acids, Actisaf, choline chloride, Optisweet-sucrem, Zympex 006, ZnO, Ory dry.

Feed Sample Analyses

A feed sample was ground to pass through a 2-mm screen before analysis and analyzed according to the standard methods of AOAC Int. (2005). The control diet sample was analyzed for DM (934.01), CP (984.13), crude fat (920.39), crude fiber (962.09), ash (942.05), Ca (927.02), and P (965.17). These analyses were performed by Department of Animal Nutrition in Nong Lam University, HCMC. In addition, the control diet sample analyzed by Zinpro Animal Nutrition Inc. (Thailand) contained 1900 ppm Zn, 19 ppm Cu, 46 ppm Mn, 467 ppm Fe, and 0.38 ppm Se.

Table 2. Analyzed chemical composition of the basal diet (as-fed basis)[1]

ME, kcal/kg[2]	3350
DM, %	89.53
CP, %	19.63
Ether extract, %	5.81
Crude fiber, %	2.12
Ash, %	6.51
Ca, %	1.23
Total P, %	0.68

[1]Analyzed by Department of Animal Nutrition, Nong Lam University, Ho Chi Minh City.

[2]Calculated ME provided by the commercial pig farm.

Measurement of Pig Performance, Mortality Rate, and Antibiotic Treatment

The initial BW of pigs in each pen was recorded at the commencement of the experiment (28 d of age). The final pen weights and feed intake measurements were determined at the end of the experiment (56 days of age). The ADG, ADFI, and F:G were calculated on a per-pen basis. The number of dead pigs from each pen was recorded daily to calculate the pig mortality rate. The number of antibiotic treatments per pen was also recorded daily to calculate the frequency of antibiotic treatment.

Statistical Analysis

Data were analyzed as a randomized complete block design by ANOVA using the GLM procedure (SAS Inst. Inc., Cary, NC). The pen was considered the experimental unit for ADFI, BW, ADG, and FCR, whereas each individual pig was considered the experimental unit for the other parameters. When a significant *F* value for treatment means was observed in analysis of variance, the treatment means were compared using Tukey's test. The pig mortality rate, incidence of diarrhea, and frequency of medical treatments were compared by Chi-square test. Treatment effects were considered significant at $P < 0.05$.

RESULTS AND DISCUSSION

The ADG of pigs fed the Availa-Starter 123-supplemented diet (368.2 g) was greater than ($P = 0.021$) that of pigs fed the control diet (345.3 g) during the experimental period (Table 3). A similar trend was also observed between the two treatments for the final BW of pigs. Particularly, the Availa-Starter 123 (18.14 kg/pig) increased ($P = 0.020$) the final BW of pigs as compared with the control (17.55 kg/pig). The diet supplemented with Availa-Starter 123 did not affect ADFI and F:G of pigs as compared with the control ($P > 0.05$). Although the diet supplemented with Availa-Starter 123 (0%) had a lower pig mortality rate than the control (2.22%), this difference was not statistically significant ($P = 0.155$; Figure 1). Similarly, no differences ($P > 0.05$) between the two treatments were observed in the incidence of diarrhea (Figure 2A) and number of antibiotic treatments (Figure 2B).

Table 3. Effects of dietary supplementation of Availa-Starter 123 on growth performance of nursery pigs

Item	Dietary treatments[1]		SEM	*P*
	Control	Availa-Starter 123		
Initial BW, kg/pig	7.45	7.46	0.02	0.528
Final BW, kg/pig	17.55	18.14	0.12	0.020
ADFI, g	455.6	475.0	11.62	0.291
ADG, g	345.3	368.2	4.89	0.021
F:G, kg/kg	1.317	1.288	0.02	0.326

[1]6 pens/treatment and 15 pigs/pen.

The results of this study indicate that addition of Availa-Starter 123 to the current diet improves the final BW and ADG of weaned pigs. The reason for this improvement may be due to the inadequate supply of trace elements for fast-growing piglets by the control diet. Thus, the supplementation of a small amount of Availa-Starter 123 in the control diet would, to a certain extent, meet the trace element requirements of young pigs. Thomaz et al. (2015) reported that when meeting 100% of the trace element requirements of nursery pigs, there were no differences in ADG and F:G between inorganic or organic trace element supplements. However, Mello et al. (2012) showed that a basal diet supplemented with organic trace elements meeting 25% of the pig requirements had the same growth performance with that supplemented with inorganic trace elements meeting 100% of the pig requirements. This may suggest that inorganic trace element premixes can be replaced with organic trace element premixes at a lower level of inclusion in diets for weaned pigs. In the current study, although not affecting the feed efficiency, Availa-Starter 123 added to a commercial diet exerted its effect through improving the growth performance of weaned pigs.

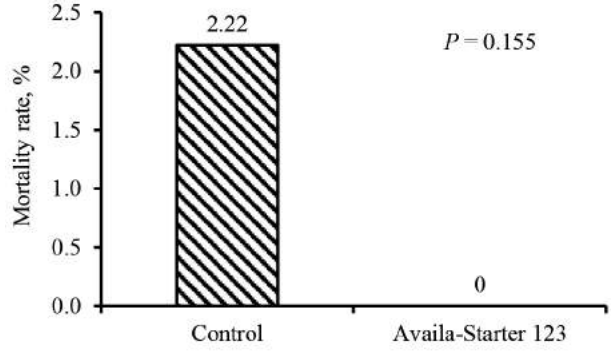

Figure 1. Pig mortality rate during the experimental period (90 pigs/treatment).

Dietary supplementation of Availa-Starter 123 did not affect the incidence of diarrhea (Figure 2A) and number of antibiotic treatments (Figure 2B) in pigs as compared with the control diet. These results are in agreement with previous studies in which the diarrhea incidence of pigs consuming diets supplemented with either organic or inorganic trace element sources was similar to that of pigs consuming the negative

control diet (Mello et al., 2012; Thomaz et al., 2015). In addition, it appears that Availa-Starter 123, to a certain extent, may elicit a positive health effect as no dead pigs were found in the Availa-Starter 123-supplemented diet (0%), whereas there were 2 dead pigs recorded in the control diet (2.22%; Figure 1). In reality, this difference implies that supplementing a diet with Availa-Starter 123 may be economically favorable to pig producers under commercial conditions. Further research on this effect is needed.

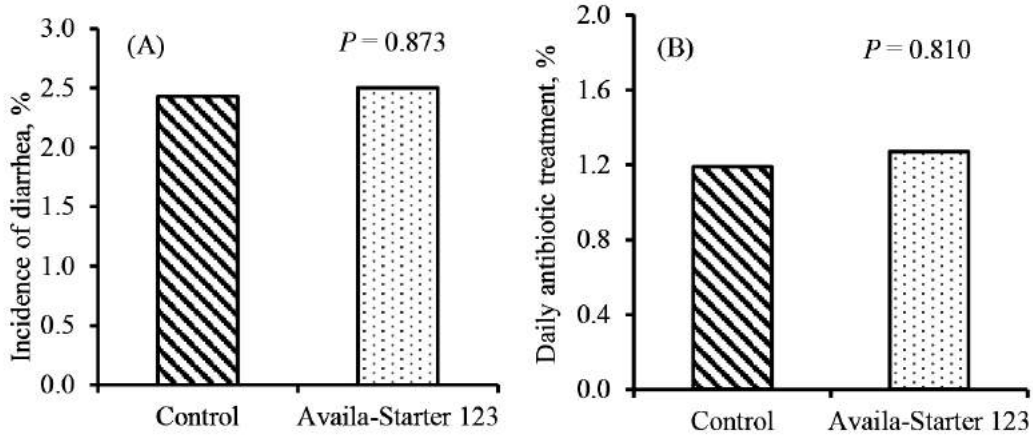

Figure 2. A) Incidence of diarrhea and B) frequency of antibiotic treatments during the experimental period (90 pigs/treatment).

CONCLUSIONS

Addition of Availa-Starter 123 to a commercial nursery diet containing inorganic trace minerals improved the growth performance of pigs as it increased the ADG and final BW of pigs. Thus, further evaluation on partial or full replacement of inorganic trace mineral premix by Availa-Starter 123 in weaned pig diets is needed to fully exploit its benefits under commercial conditions.

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