

Botanicals for Pigs – Garlic II

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Summary and Implications

Botanicals have been proposed as a substitute for antimicrobials in swine diets because of potential natural antibacterial activity. Garlic (*Allium sativum*), a botanical that grows in Iowa, was compared with a standard antibacterial nursery dietary regimen. A trial conducted in 1997 had inclusion levels of 0.0, 0.5, 2.5 and 5%. These levels of garlic generally depressed feed intake and average daily gain in nursery pigs and depressed performance compared with the control diet with Mecadox. Muscle samples from the garlic-fed pigs all had “very objectionable” or “extremely objectionable” off-flavors.

This trial fed inclusion levels of 0.00, 0.10, 0.25, and 0.50% garlic, levels that hopefully would be low enough not to depress performance or alter meat flavors. Pigs fed diets without Mecadox demonstrated significantly poorer performance than with Mecadox inclusion. Based upon this and the 1997 studies at Iowa State University, pigs fed diets without Mecadox performed less well than those fed Mecadox. The addition of garlic did not enhance pig performance.

Introduction

The historic use of herbal remedies to treat and prevent infectious disease has been supplanted with the emergence of specific synthetic chemotherapeutic and antibacterial agents. However, selected herbs are known to possess natural antibacterial activity and other characteristics that could be useful in value-added animal protein production. Several medicinal herbs can be effectively grown in Iowa. One of these, garlic (*Allium sativum*), a member of the lily family, is a perennial plant cultivated worldwide. Garlic bulbs, either fresh or dehydrated, may be used for medicinal purposes. The bulbs contain a volatile oil composed of allicin, diallyl disulfide, and diallyl trisulfide, which are considered the reservoirs for most pharmacological properties attributable to garlic. Garlic demonstrates a broad-spectrum antimicrobial activity against many bacteria, viruses, parasites, and fungi.

A garlic study reported in the 1998 ISU Swine Research Report (1) noted that increasing levels of garlic depressed feed intake and average daily gain in nursery pigs and depressed performance compared with the control diet containing Mecadox. This experiment was designed to evaluate the effects of levels much lower than those previously fed.

Materials and Methods

The experiment was conducted at the ISU Swine Nutrition and Management Center in a temperature regulated nursery room starting in September 1999. The garlic powder was purchased from Nature’s Cathedral, 1995 78th St., Blairstown, IA 52209. One hundred twenty pigs were weaned at an average age of 18 days (14 to 21) and 15.2 lb (6.9 kg). Pigs were randomly allotted to pens by litter and initial weight. There were 20 pens of six pigs each, providing four replications of five dietary treatments. Each pen of six pigs received 165 lb (75 kg) of the prestarter treatments and then was switched to the starter treatment diets for the remainder of the five-week study (Table 1). The positive control diet contained 50 g of Mecadox (carbadox) per ton and the other treatments consisted of the same diet without Mecadox. Increasing levels of garlic powder (0.00, 0.10, 0.25 and 0.50%) replaced corn. The 0% garlic was considered to be the negative control.

Pigs were grown in 4 x 4 ft raised deck pens and the average room temperature was 75 ±5°F. Heat mats supplied supplemental heat. Pigs were weighed and feed disappearance was measured weekly. Upon completion of the nursery phase, pigs were fed the standard farm grower (40 g Tylan/ton) and finisher (30 g BMD/ton) diets and weight gains were measured every four weeks for 12 weeks to evaluate any long-term effects of the garlic additions. Data were analyzed using the GLM procedure of SAS with the pen as the experimental unit.

One pig from each of the garlic treatments (0–0.5%) was taken to the ISU Meat Laboratory, slaughtered, and various muscles were evaluated for sensory and quality characteristics at the end of the nursery trial. Based on the previous study that indicated that garlic flavors were present in the muscle, one pig each that had received the 0.0 and 0.50% garlic nursery diets were slaughtered and the muscle evaluated at two and four weeks after removal from the garlic diets.

Results and Discussion

Two pigs died, one on the Mecadox diet and the other on the 0.25% garlic diet. Reported data are cumulative from the start of the experiment as well as weekly. Least square means are presented in Tables 2 and 3.

No cumulative performance differences were significant the first two weeks of the experiment. Cumulative performance for weeks 0–3, 0–4 and 0–5 indicated significantly better performance for pigs fed the Mecadox control diet over the other four treatments. Additions of garlic failed to provide any performance boost over pigs fed the control diet without garlic. In weeks 0–4 there was a linear trend for pigs fed increasing levels of garlic to have slightly poorer feed efficiency ($P < .05$). No statistical differences were observed in daily gain in the post-nursery phase.

Weekly performance data (Table 3) indicated that pigs fed the Mecadox diet grew significantly faster and ate significantly more feed in the third and fourth weeks as well as more feed in the fifth week. There were no statistical differences observed during the post-nursery phase.

Table 4 reports the results of garlic levels on muscle quality. One pig from each of the four garlic treatments was slaughtered at the ISU Meat Laboratory. Three muscles, the *Longissimus dorsi* (loin muscle), the *Semimembranosus* (inside ham muscle) and *Serratus ventralis* (large shoulder muscle) were evaluated by a trained panel in the ISU Food Science and Human Nutrition laboratory. No statistical data are presented because only one pig per treatment was

evaluated. Muscle samples from the control diet were not tested because of the withdrawal period required when feeding Mecadox (42 days). Average values of the three muscles indicate little difference across the treatments. Off-flavor scores were detected in each pig at the end of the nursery study. However none of the off-flavors were garlic. It is possible that the trained taste panel is accustomed to sampling the cooked muscle from market weight pigs (240–260 lb). The muscle from immature 50 lb pigs has a much different flavor and texture than from older pigs.

At the end of the nursery trial, all pigs had very low garlic flavor scores (1 to 10 range, 1 is no flavor detected). After two weeks on the standard farm grower diet without garlic, no garlic flavor was detected. After four weeks, the second 0.50% garlic pig slaughtered had a moderate garlic flavor score of 5.0. This is difficult to explain as garlic flavor was not detected at the end of the garlic feeding study.

References

1. Holden, P., et al. 1998. Botanicals for pigs – Garlic (ASL-R1559). 1998 ISU Swine Research Report, AS-640. Pp. 23-26. Iowa State University, Ames, IA 50011.

Acknowledgements

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Table 1. Diet composition. 9915A

Prestarter	Mecadox		Garlic level		
	control	0.00%	0.10%	0.25%	0.50%
Corn	35.43	36.43	36.33	36.18	35.93
Dried whey	25.00	25.00	25.00	25.00	25.00
Appetein (plasma protein)	5.00	5.00	5.00	5.00	5.00
Soybean meal, dehulled	29.20	29.20	29.20	29.20	29.20
Dicalcium phosphate	1.65	1.65	1.65	1.65	1.65
Limestone	0.90	0.90	0.90	0.90	0.90
Salt	0.00	0.00	0.00	0.00	0.00
Lysine, synthetic	0.20	0.20	0.20	0.20	0.20
Methionine, DL	0.10	0.10	0.10	0.10	0.10
SN Vitamins	0.40	0.40	0.40	0.40	0.40
SN Trace minerals	0.07	0.07	0.07	0.07	0.07
SN Selenium	0.05	0.05	0.05	0.05	0.05
Animal fat, stabilized	1.00	1.00	1.00	1.00	1.00
Mecadox 2.5	1.00	0.00	0.00	0.00	0.00
Garlic	0.00	0.00	0.10	0.25	0.50
Total	100.00	100.00	100.00	100.00	100.00

Starter	Mecadox		Garlic level		
	control	0.00%	0.10%	0.25%	0.50%
Corn	50.56	51.56	51.46	51.31	51.06
Dried whey	10.00	10.00	10.00	10.00	10.00
Soybean meal, dehulled	33.50	33.50	33.50	33.50	33.50
Dicalcium phosphate	2.20	2.20	2.20	2.20	2.20
Limestone	0.78	0.78	0.78	0.78	0.78
Salt	0.25	0.25	0.25	0.25	0.25
Lysine, synthetic	0.20	0.20	0.20	0.20	0.20
Methionine, DL	0.10	0.10	0.10	0.10	0.10
SN Vitamins	0.30	0.30	0.30	0.30	0.30
SN Trace minerals	0.06	0.06	0.06	0.06	0.06
SN Selenium	0.05	0.05	0.05	0.05	0.05
Animal fat, stabilized	1.00	1.00	1.00	1.00	1.00
Mecadox 2.5	1.00	0.00	0.00	0.00	0.00
Garlic	0.00	0.00	0.10	0.25	0.50
Total, %	100.00	100.00	100.00	100.00	100.00

Calculated analysis of control diet (%):

	Prestarter	Starter
Lysine	1.46	1.28
Methionine + cystine	0.88	0.66
Calcium	0.79	0.79
Phosphorus, total	0.72	0.70
Phosphorus, available	0.48	0.41

Table 2. Cumulative effect of garlic on pig performance 9915A.

Garlic	Mecadox	0.00%	0.10%	0.25%	0.50%
Init wt, lb	15.4	14.7	15.0	15.4	15.7
5 week wt	50.4	45.2	46.3	46.8	44.7
17 week wt	212.4	209.8	213.8	213.9	206.2
Garlic	Mecadox	0.00%	0.10%	0.25%	0.50%
Week 0–1					
ADG	0.33	0.29	0.35	0.26	0.31
ADF	0.51	0.46	0.53	0.48	0.46
F/G	1.49	1.64	1.54	1.85	1.52
Week 0–2					
ADG	0.40	0.33	0.35	0.35	0.29
ADF	0.66	0.57	0.62	0.64	0.57
F/G	1.67	1.82	1.75	1.82	1.96
Week 0–3					
ADG ^a	0.68	0.57	0.57	0.57	0.53
ADF ^b	0.97	0.84	0.86	0.90	0.82
F/G ^c	1.41	1.45	1.52	1.56	1.54
Week 0–4					
ADG ^a	0.86	0.73	0.75	0.73	0.66
ADF ^a	1.28	1.08	1.12	1.12	1.06
F/G ^d	1.47	1.49	1.49	1.54	1.56
Week 0–5					
ADG ^a	1.01	0.88	0.90	0.90	0.84
ADF ^a	1.50	1.26	1.34	1.37	1.26
F/G	1.49	1.47	1.52	1.52	1.52
ADG, lb					
Week 0-9	1.30	1.21	1.26	1.28	1.15
Week 0-13	1.50	1.45	1.48	1.52	1.39
Week 0-17	1.70	1.68	1.72	1.72	1.65

^a Mecadox vs all P < .003.^b Mecadox vs all P < .01.^c Mecadox vs all P < .03.^d Garlic linear P < .05.**Table 3. Weekly effect of garlic on pig performance 9915A.**

Garlic	Mecadox	0.00%	0.10%	0.25%	0.50%
Week 1–2					
ADG	0.44	0.35	0.35	0.44	0.26
ADF	0.79	0.68	0.71	0.77	0.68
F/G	1.79	1.96	1.96	1.75	2.50
Week 2–3					
ADG ^a	1.30	1.06	1.01	0.99	0.99
ADF ^a	1.56	1.34	1.37	1.39	1.28
F/G	1.22	1.25	1.35	1.39	1.30
Week 3-4					
ADG ^a	1.39	1.17	1.28	1.19	1.10
ADF ^b	2.16	1.81	1.90	1.81	1.79
F/G	1.52	1.52	1.47	1.52	1.61

Week 4–5

ADG	1.54	1.48	1.45	1.56	1.48
ADF ^a	2.42	2.14	2.25	2.34	2.14
F/G	1.56	1.45	1.54	1.47	1.45
ADG, lb					
Week 5–9	1.68	1.63	1.72	1.76	1.56
Week 9–13	2.01	2.07	2.00	2.07	1.94
Week 13–17	2.34	2.40	2.47	2.38	2.56

^a Mecadox vs all P < .005^b Mecadox vs all P < .003**Table 4. Effect of garlic on pig muscle. End of nursery trial**

Garlic, %	0.00%	0.10%	0.25%	0.50%
Juiciness	5.7	6.3	7.3	7.7
Tenderness	7.0	7.3	8.3	6.3
Chewiness	3.0	2.0	1.7	3.0
Flavor score	1.0	1.0	1.0	1.0
Off-flavor score	5.0	4.7	3.7	3.3
Off-flavor	Sour, liver	Sour, liver	Sour, liver	Sour, metallic
Garlic score	1.0	1.0	2.0	1.0

Two weeks no garlic in diet

Garlic, %	0.00%	0.50%
Juiciness	9.3	9.0
Tenderness	9.7	7.3
Chewiness	1.7	3.0
Flavor score	1.7	1.3
Off-flavor score	3.3	4.0
Off-flavor	Sour, liver, metallic	Sour, liver
Garlic score	1.0	1.0

Four weeks no garlic in diet

Garlic, %	0.00%	0.50%
Juiciness	5.0	5.3
Tenderness	7.7	6.3
Chewiness	3.3	3.7
Pork flavor score	1.0	1.0
Off-flavor score	5.0	3.5
Off-flavor	Sour, liver	Sour
Garlic score	1.0	5.0

Values are from one pig per treatment at each time period.

For all the sensory attributes, 1 = lowest degree of the attribute and 10 = highest degree of the attribute such that; For juiciness: 1 = not juicy, 10 = very juicy
 For tenderness: 1 = not tender, 10 = very tender
 For chewiness: 1 = not chewy, 10 = very chewy
 For pork flavor: 1 = no pork flavor, 10 = intense pork flavor. For off-flavors: 1 = no off flavor, 10 = intense off flavor. For juiciness, tenderness and pork flavor, the higher the number desired. For chewiness and off-flavors, the lower the score is desired.