Botanicals for Pigs – Garlic

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Summary and Implications

Botanicals have been proposed as a substitute for antimicrobials in swine diets because of their natural antibacterial activity. Garlic, a botanical that grows in Iowa, was compared with a standard antibacterial nursery dietary regimen. At the tested inclusion levels (0.5, 2.5 and 5%) increasing levels of garlic generally depressed feed intake and average daily gain in nursery pigs and depressed performance compared with the positive control diet with Mecadox. Muscle samples from the garlic-fed pigs all had very objectionable or extremely objectionable off-flavors.

Introduction

The historic use of herbal remedies to treat and prevent infectious disease has been supplanted with the emergence of specific man-made chemotherapeutic and antibacterial agents. Selected herbs, however, are known to possess natural antibacterial activity and other characteristics that could be useful in value-added animal protein production. This area of investigation has not received substantive examination because of the relatively low costs, proven effectiveness, and ready availability of synthetic growth-promoting antibacterial products. The possibility of significant antibiotic-resistant bacterial development through the use of human drugs in animals and subsequent transfer of this resistance to human pathogens has caused concerns within the medical community. Inclusion of herbs in animal feeds as alternative growth-promotion and efficiency-stimulating strategies can address some of these concerns while producing a more holistically grown pork product.

Several medicinal herbs can be effectively grown in Iowa. One of these is garlic (*Allium sativum*), a member of the lily family and 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 that is considered the reservoir for most pharmacologic properties attributable to garlic. Garlic demonstrates a broad-spectrum antimicrobial activity against many bacteria, viruses, parasites, and fungi. Fresh and vacuum-dried powdered garlic preparations have demonstrated antimicrobial activity against multiple bacteria, including *Staphylococcus aureus, Streptococcus* sp., *E. coli, Proteus vulgaris, Salmonella enteriditis, Klebsiella pneumoniae,* and mycobacterium. Garlic inclusion rates of 2 to 4% in feeds had a protective effect on chickens subjected to experimental candidiases and feed containing 5% garlic eliminated candida infection. Garlic has shown effective antiviral activity and possesses activity against common intestinal roundworms and hookworms. In addition to antimicrobial effects garlic exhibits hypoglycemic and hypolipemic activity, antihypertensive, anticoagulant, and immune-system-modulation characteristics.

Clinically, commercial garlic preparations with concentrated quantities of allicin appear most effective. Alliin is relatively odorless until converted to allicin in the body. This characteristic makes such products more socially acceptable. The conversion of alliin to allicin is approximately 40% effective. Commercial products for human consumption should provide a daily dose of at least 10 milligrams alliin or a total allicin potential of 4 milligrams (approximately 1 clove [4 gm] of fresh garlic) (1). Garlic at therapeutic levels is considered nontoxic, but prolonged feeding of large quantities of raw garlic to rats has caused anemia, weight loss, and failure to thrive.

Materials and Methods

The experiment was conducted at the ISU Swine Nutrition and Management Center in a temperature-regulated nursery room starting in October 1997. The garlic was purchased from Nature's Cathedral, 1995 78th St., Blairstown, IA 52209. Eighty pigs were weaned at an average age of 21 days and 13.6 lb. Pigs were allotted at random to pens by litter and initial weight. There were 20 pens of four pigs each providing four replications of five dietary treatments. Each pen of four pigs received 63 lb of the prestarter treatments and then was switched to the starter treatment diets for the remainder of the 5–week study (Table 1). The positive control diet contained 50 g of Mecadox (carbadox) per ton and the other treatments were the same diet without Mecadox. Increasing levels of garlic powder (0.0, 0.5, 2.5 and 5.0%) 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. They were weighed and feed disappearance was determined weekly. Data were analyzed using the GLM procedure of SAS with the pen as the experimental unit.

One pig from each of the garlic treatments was taken to the ISU Meat Laboratory, slaughtered and various muscles were evaluated for sensory and quality characteristics.

Results and Discussion

Two pigs died, both on 2.5% garlic, in first and fourth weeks of the experiment. Reported data are cumulative from the start of the experiment. Least square means are presented in Table 2.

The first observation was that the room and adjacent hallway had a very strong, objectionable odor of garlic combined with hog manure throughout the entire study.

The overall summary, weeks 0–5, indicated the control diet with Mecadox significantly improved daily gain compared with the garlic treatments ($P<.01$ and $P<.05$,), generally the higher the level of garlic, the poorer the daily gain. Control ADG was slightly improved over the 0% garlic ($P<.10$). Control ADF was significantly greater than the 5% level of garlic ($P<.05$) and greater than the 0 and 2.5% garlic levels ($P<.10$). Overall feed efficiency was best for the 0% garlic (negative control) but was statistically different only when compared with the 2.5% garlic treatment.

The highest level of garlic, 5.0%, significantly reduced feed intake in weeks 0–2, 0–3 and 0–5 compared with the control diet ($P<.01$ and $P<.05$). Additionally, in weeks 0–3 as the level of garlic increased, feed intake decreased.

Table 3 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 as 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 (70 days). Footnotes from Table 3 indicate expected values for market hogs and may not be applicable to 40–50 lb pigs. Additionally the sour, livery taste may be typical of young pigs and not related to the garlic.

Average pH values increased and cooking losses decreased with added garlic. Flavor scores were very low, probably typical of immature pigs. All pigs sampled had strong off-flavors, with scores from 4.33 to 9.33, increasing as the garlic level increased. The 0% garlic samples had a sour, livery taste and the samples from the garlic-fed pigs had very objectionable and extremely objectionable off-flavors. Hunter Lab L* appeared to be similar for all treatments.

Reference

1. Murray, M.T. 1995. The Healing Power of Herbs. 2nd ed. Prima Publishing. Rocklin, CA. pp. 121-129.

Table 1. Diet composition.

Prestarter Garlic level	Control	0.0%	0.5%	2.5%	5.0%
Corn, yellow	33.05	34.05	33.55	31.55	29.05
Soybean meal, dehulled	27.70	27.70	27.70	27.70	27.70
Garlic	0.00	0.00	0.50	2.50	5.00
Dicalcium phosphate	1.16	1.16	1.16	1.16	1.16
Limestone	0.74	0.74	0.7	0.74	0.74
Lactose	10.00	10.00	10.00	10.00	10.00
ISU Mineral Premix	0.05	0.05	0.05	0.05	0.05
ISU Vitamin Premix	0.20	0.20	0.20	0.20	0.20
Plasma protein	5.00	5.00	5.00	5.00	5.00
Whey, dried	20.00	20.00	20.00	20.00	20.00
Soybean oil	1.00	1.00	1.00	1.00	1.00
Methionine, DL	0.10	0.10	0.10	0.10	0.10
L Lysine HCl	0.00	0.00	0.00	0.00	0.00
Mecadox 2.5	1.00	0.00	0.00	0.00	0.00
Total, %	100.00	100.00	100.000	100.00	100.00

Table 1 continued…

Starter

Garlic level	Control	0.0%	0.5%	2.5%	5.0%
Corn, yellow	55.93	56.93	56.43	54.43	51.93
Soybean meal, dehulled	29.10	29.10	29.10	29.10	29.10
Garlic	0.00	0.00	0.50	2.50	5.00
Dicalcium phosphate	1.51	1.51	1.51	1.51	1.51
Limestone	0.76	0.76	0.76	0.76	0.76
Salt	0.25	0.25	0.25	0.25	0.25
ISU Mineral Premix	0.05	0.05	0.05	0.05	0.05
ISU Vitamin Premix	0.20	0.20	0.20	0.20	0.20
Whey, dried	10.00	10.00	10.00	10.00	10.00
Soybean oil	1.00	1.00	1.00	1.00	1.00
Methionine, DL	0.00	0.00	0.00	0.00	0.00
L Lysine HCl	0.20	0.20	0.20	0.20	0.20
Mecadox 2.5	1.00	0.00	0.00	0.00	0.00
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. Effect of garlic on pig performance.

Garlic	Control	0.0%	0.5%	2.5%	5.0%
Week 1					
ADG, lb [a]	0.24	0.15	0.20	0.20	0.07
ADF, lb	0.42	0.37	0.40	0.40	0.33
F/G	1.84	0.88	3.04	-0.50	4.19
Week 0–2					
ADG, lb [bc]	0.59	0.51	0.46	0.46	0.37
ADF, lb [cd]	0.79	0.70	0.68	0.66	0.55
F/G	1.34	1.42	1.51	1.56	1.45
Week 0–3					
ADG, lb [ef]	0.75	0.53	0.57	0.53	0.48
ADF, lb [g]	1.10	0.97	0.92	0.90	0.77
F/G	1.48	1.90	1.66	1.80	1.65
Week 0–4					
ADG, lb	0.84	0.70	0.68	1.12	0.59
ADF, lb	1.34	1.17	1.17	2.11	1.03
F/G [h]	1.6	1.67	1.72	1.91	1.74
Week 0–5					
ADG, lb [i]	0.99	0.86	0.84	0.75	0.77
ADF, lb [j]	1.63	1.34	1.50	1.36	1.28
F/G [k]	1.66	1.56	1.81	1.88	1.65

[a] Control vs. 5.0%, P<.10
[b] Control vs. 0.5 & 2.5%, P<.10
[c] Control vs. 5.0%, P<.01
[d] 0.0% vs. 5.0%, P<.10
[e] Control vs. 0.0, 0.5, & 2.5%, P<.05
[f] Control vs. 5.0%, P<.01

Table 2 continued…

[g] Control vs. 2.5%, P<.05; vs. 5.0%, P<.01: 0.0 vs. 5.0%, P<.05: 2.5% vs. 5.0%, P<.10
[h] Control vs. 2.5%, P<.05: 0.0% vs. 2.5%, P<.10
[i] Control vs. 0.0%, P<.10: Control vs. 0.5%, P<.05: Control vs. 2.0 & 5.0%, P<.01
[j] Control vs. 0.0 & 2.5%, P<.10: Control vs. 5.0%, P<.05
[k] 0.0% vs. 2.5%, P<.05

Table 3. Effect of garlic on pig muscle.

Garlic level	0.0%	0.5%	2.5%	5.0%
pH	5.85	6.12	6.74	6.70
Cooking loss, %	24.53	22.42	19.18	19.07
Flavor score	1.33	1.00	1.33	1.00
Off-flavor score	4.33	5.33	7.00	9.33
Off-flavors	Sour	Very Livery	Objectionable	Extremely Objectionable
Hunter Lab L*	50.0	50.6	47.0	49.5

The pH is the ultimate pH of raw loin muscle. Low quality loins (PSE) will have pH values as low as 5.1 and as high as 5.4. Flavor score is from 1 to 10 with low scores indicating less flavor. Off-flavor score is from 1 to 10 with low values indicating no or small off-flavors. Hunter Lab values are a measurement of the amount of lightness/darkness measured with a Hunter Lab colorimeter. The greater the values, the lighter the muscle color. Generally, lower numbers or a darker muscle color is preferred.

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