Botanicals for Pigs – Echinacea

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ASL-R1560

Summary and ImplicationS

Botanicals have been proposed as a substitute for antimicrobials in swine diets because of their natural antibacterial activity. Echinacea, a botanical that grows in Iowa, was compared with a standard antibacterial nursery dietary regimen. At the tested inclusion levels (0.1, 0.5 and 2.0%) no statistical advantage existed when compared with a positive control diet with 50 g/ton Mecadox or with a negative control containing no antibacterial inclusions. Echinacea-treated pigs exhibited a slight, but not objectionable, off-flavor compared with noninclusion levels. Higher levels of Echinacea inclusions may be required to enhance growth rate and feed efficiency swine production.

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, *Echinacea spp.*, or purple coneflower, is purported to possess antibacterial activity under some conditions. *Echinacea spp*. are perennial herbs capable of growth throughout the midwestern United States. There are nine species, but *E. augustifolia*, *E. purpurea* and *E. pallida* are most commonly considered for medicinal purposes. The whole plant, including the aerial portions and tap roots, have been utilized for medicinal preparations.

Polysaccharides, inulin and other heteroglycans of *Echinacea spp.* possess immuno-enhancing properties. These effects may occur because of the activation of the alternate complement pathway through increased properdin production or through non-specific T-cell activation. The T-cell activation results in enhanced replication, macrophage phagocytoxis, and antibody binding capabilities. Additionally, pressed juice from the aerial portion of *E. purpurea* and aqueous and alcohol extracts of the roots have viral inhibition characteristics in cell culture. Echinacea (as echinacoside) possesses mild antibacterial activity against *Corynebacterium* sp., *Proteus* sp., *E. coli*, and *Staphylococcus aureus*. Approximately 6.3 mg of echinacoside is equivalent in antibacterial activity to 10 Oxford units of penicillin (1).

Commercial preparations containing 3.5% echinacoside (125 mg) in capsular form or in liquid form are available for human use. Recommended human dosages for control of flu-like symptoms are 900 mg daily (2) and 500 to 1000 mg daily for general immune stimulation (3). Substantially higher dosages may be recommended for treatment of acute infection (4). Echinacea, even at high dosages, appears relatively nontoxic (4). The LD_{50} for the polysaccharides of the *E. purpurea* aerial portions was 1,000–2,500 mg/kg when injected intraperitoneally into mice. Chronic administration of high dosages to rats demonstrated no toxic effects (5).

Materials and Methods

The experiment was conducted at the ISU Swine Nutrition and Management Center starting in January 1998 and lasting five weeks. The Echinacea was purchased from Nature's Cathedral, 1995 78th St., Blairstown, IA 52209. One hundred pigs were weaned at an average age of 21 days and 12.15 lb and immediately placed on the experimental diets. They were grown in 4 x 4 ft raised-deck pens with woven wire floors. Each pen had a 1 x 4 ft heat pad, a stainless steel self-feeder, and a nipple drinker. The heat pads supplied supplemental heat for the first two weeks. Room temperature was maintained at 75±5°F.

Pigs were allotted at random on the basis of initial weight and litter to blocks of pens. There were

20 pens of five pigs each providing four replications of five dietary treatments. Each pen of five pigs received approximately 16 lb of the prestarter treatments and then was switched to the starter treatment diet for the remainder of the study (Table 1). The control diet contained 50 g of Mecadox (carbadox) per ton and the other treatments were the same diet without Mecadox. Increasing levels of echinacea (0.0, 0.1, 0.5 and 2.0%) replaced corn. The Echinacea was analyzed by Industrial Laboratories, 1450 East 62nd Ave, Denver, CO 80216 and contained 0.08% echinacoside wt/wt.

Pigs 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 echinacea treatments was taken to the ISU Meat Laboratory, slaughtered and various muscles were evaluated for sensory and quality characteristics.

Results and Discussion

No pigs died or were removed from the study. Reported data are cumulative from the start of the experiment. Least square means are presented in Table 2.

In week 1 there were no statistical differences indicating similar performance between the treatments. In the 0–2 week period the 0% Echinacea treatment required significantly more feed than the other treatments but daily gain and feed intake were not statistically different. In weeks 0–3 and 0–4 the two high levels of Echinacea were significantly more efficient in feed efficiency ($P<0.05$) but daily gain and feed intake were not statistically different. Total performance for the entire experiment, weeks 0–5, was not statistically different.

These data suggest that in the experiment higher levels of Echinacea enhanced feed efficiency compared to the 0% Echinacea during the first two weeks and were greater than the positive control diet with Mecadox during the 0–3 and 0–4 week periods. Overall, performance was similar over all treatments, suggesting minimal subclinical stress during this experiment.

Table 3 reports the results of Echinacea levels on muscle quality. The ISU Department of Food Science and Human Nutrition evaluated one pig from each of the Echinacea treatments with only one pig from each treatment. No statistical comparison is possible. Footnotes from Table 3 indicate expected values for market hogs and may not be applicable to 40 or 50 pound pigs. Flavor scores, pH and Hunter Lab values were similar for all treatments. The two highest levels of Echinacea had a higher cooking loss and the highest level tended to have a higher off-flavor score, but was not objectionable. The off-flavors were sour and/or livery tastes and may be more typical of immature pigs than of market weight pigs.

References

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Table 1. Diet composition.

Prestarter

Echinacea level	Control	0.0%	0.1%	0.5%	2.0%
Corn, yellow	33.00	34.00	33.90	33.50	32.00
Soybean meal, dehulled	27.76	27.76	27.76	27.76	27.76
Echinacea	0.00	0.00	0.10	0.50	2.00
Dicalcium phosphate	1.16	1.16	1.16	1.16	1.16
Limestone	0.74	0.74	0.74	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	100.00	100.00	100.00

Table 1 continued…

Starter

Echinacea level	Control	0.0%	0.1%	0.5%	2.0%
Corn, yellow	55.94	56.94	56.84	56.44	54.92
Soybean meal, dehulled	29.10	29.10	29.10	29.10	29.10
Echinacea	0.00	0.00	0.10	0.50	2.00
Dicalcium phosphate	1.50	1.50	1.50	1.50	1.50
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 analyses of control diets (%):

	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 echinacea on pig performance

Echinacea	Control	0.0%	0.1%	0.5%	2.0%
Week 1					
ADG, lb	0.24	0.24	0.22	0.24	0.22
ADF, lb	0.46	0.51	0.46	0.44	0.42
F/G	2.06	2.08	1.98	1.85	2.04
Week 0–2					
ADG, lb	0.44	0.35	0.37	0.40	0.37
ADF, lb	0.72	0.68	0.64	0.64	0.64
F/G [ab]	1.62	1.93	1.71	1.62	1.65
Week 0–3					
ADG, lb [c]	0.55	0.48	0.51	0.53	0.53
ADF, lb	0.90	0.86	0.84	0.84	0.86
F/G [d]	1.66	1.79	1.65	1.57	1.59
Week 0–4					
ADG, lb [e]	0.70	0.64	0.66	0.66	0.68
ADF, lb	1.12	1.08	1.06	1.06	1.10
F/G [ef]	1.60	1.71	1.62	1.58	1.58
Week 0–5					
ADG, lb	0.84	0.77	0.77	0.79	0.81
ADF, lb	1.41	1.34	1.30	1.32	1.34
F/G	1.65	1.73	1.68	1.65	1.66

[a] Control vs. 0.0%, P<.05

[b] 0.0% vs. 0.1%, P<.05; vs. 0.5 & 2.0%, P<.01

[c] Control vs. 0.0%, P<.10

[d] 0.0% vs. 0.5 & 2.0%, P<.05

[e] Control vs. 0.0%, P<.10

[f] 0.0% vs. 0.1%, P<.10; vs. 0.5 & 2.0%, P<.02

[g] Control vs. 0.0 & 0.1%, P<.10

Table 3. Effect of eEchinacea on pig muscle

Echinacea	0%	0.1%	0.5%	2.0%
pH	5.92	5.72	5.74	5.78
Cooking loss, %	20.63	21.40	28.54	29.74
Flavor score	1.00	1.67	1.33	1.00
Off-flavor score	2.00	2.33	3.33	5.33
Off-flavors	Sour	Sour Livery	Sour Livery	Sour Livery
Hunter Lab L*	48.6	50.1	46.8	48.7

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.

(Note: this research project was supported through a grant from the Leopold Center for Sustainable Agriculture, Iowa State University, Ames, IA.)