Botanicals for Pigs – Goldenseal

Palmer J. Holden, professor,
Animal Science
James McKean, professor Veterinary Medicine
Eric Franzenburg, Rural/Urban Coordinator,
Benton Development Group

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Summary and Implications

Various botanical products have been suggested to have beneficial effects as a replacement for man-made chemotherapeutic and antibacterial agents. This study evaluated four levels of goldenseal (0.0 to 1.0%) compared with a control diet control diet containing Mecadox for nursery pigs. Although not performing to the level of the Mecadox control, pigs on the 0.25 and 1.00% goldenseal diets generally performed better than ones on the 0.00 and 0.05% goldenseal diets and were often not statistically different from the Mecadox control pigs. Increasing levels of goldenseal did not influence the muscle characteristics evaluated.

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, goldenseal (*Hydrastis canadensis*), is known to possess antibacterial activity. Native to eastern North America, goldenseal is a perennial herb also grown in Iowa. The most pharmacologically active isoquinolone alkaloid, berberine, is concentrated in the rhizome and roots. Berberine has been demonstrated to possess antimicrobial, immuno-stimulatory, anticonvulsant, sedative, hypotensive, choleretic, and carminative activity. This antimicrobial activity has been demonstrated against a wide range of bacteria, protozoa, and fungi.

Berberine has demonstrated a capability to inhibit adherence of group A streptococci to host cells and effectiveness in treatment of acute diarrheal diseases caused by *E. coli* (traveler's diarrhea), *Shigella dysentariae* (shigellosis), *Salmonella paratyphi* (food poisoning), and *Vibrio cholerae* (cholera). In some cases clinical response to berberine has been comparable to standard antibacterial treatment regimens. For example, in a study of 65 children affected with acute diarrhea caused by *E. coli*, *Shigella*, *Salmonella*, or *Klebsiella*, those treated with a berberine tannate preparation responded better than did those receiving antibiotic therapy.

The effective dosage for goldenseal should be based upon the berberine content. In humans, a dried powder extract of goldenseal with 8 to 12% alkaloid content is recommended at oral dosages of 250 to 500 milligrams three times per day. Berberine and berberine-containing plants are generally considered nontoxic. The LD_{50} for berberine in rats is greater than 1,000 mg/kg of body weight.

Materials and Methods

The experiment was conducted at the ISU Swine Nutrition and Management Center in a temperature regulated nursery room starting in March 1998. The goldenseal was purchased from Nature's Cathedral, 1995 78th St., Blairstown, IA 52209. Eighty pigs were weaned at an average age of 21 days and 14.4 lb. 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 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 a prestarter treatment and then was switched to a starter treatment diet for the remainder of the four-week 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 goldenseal (0.0, 0.05, 0.25 and 1.0%) replaced corn.

The goldenseal was analyzed by Industrial Laboratories, 1450 East 62nd Ave, Denver, CO 80216, and contained 2.8% berberine and 2.4% hydrastine 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 goldenseal 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. The least square means are presented in Table 2.

Some F/Gs appear unreasonable because of an occasional pen with very poor gains with normal or high feed intakes. In week 1, the Mecadox control produced daily gains (P<.05) and feed/gain (P<.10) greater than the 0.00% goldenseal diet and feed intake greater than the 0.05% goldenseal, but not statistically different from the other treatments (P>.10). This suggests that additions of goldenseal produced performance comparable with the Mecadox control during the first week. In weeks 0–2 the control diet ADG was significantly greater than the 0.00% diet (P<.05) and tended to be greater than the three higher levels of goldenseal (P<.10). Control diet ADF tended to be greater than the goldenseal diets (P<.10). Control F/G was improved over the 0.00% and 0.05% goldenseal but not significantly different from the higher levels.

Weeks 0–3 had significantly greater ADG and ADF for the control pigs over all other treatments. The ADF of the two highest levels of goldenseal tended to be greater than the 0.00% negative control. Control diet F/G was not statistically different from the two highest levels of goldenseal and significantly greater than the 0.00 and 0.05% diets, with the two highest levels also having improved efficiency compared with the 0.05% diet. In weeks 0–4, the control diet ADG was significantly higher than the 0.00 and 0.05% goldenseal diets (P<.05) and tended to be greater than the two highest levels (P<.10). Overall feed intake was highest for the control diet. Overall feed efficiency was lowest for the control diet when compared with the 0.00 and 0.05% treatments but not statistically different from the two highest level. The two highest levels tended to be more efficient than the 0.00 and 0.05% goldenseal diets.

Table 3 reports the results of goldenseal levels on muscle quality. The ISU Department of Food Science and Human Nutrition evaluated one pig from each of the goldenseal treatments. Only one pig was evaluated from each treatment and as a result no statistical data are available. Footnotes from Table 3 indicate expected values for market hogs and they may not be applicable to 40–50 lb pigs. The pH values, flavor and off-flavor scores and Hunter Lab values were similar for all pigs. The flavor score, 1.00, indicated not much flavor was present in these young pigs. The off-flavors were sour and/or livery tastes and may be more typical of immature pigs than of market weight pigs.

Table 1. Diet composition.

Prestarter

Goldenseal level	Control	0.00%	0.05%	0.25%	1.00%
Corn, yellow	32.99	33.99	33.94	33.74	32.99
Soybean meal, dehulled	27.76	27.76	27.76	27.76	27.76
Goldenseal	0.00	0.00	0.05	0.25	1.00
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

Goldenseal level	Control	0.00%	0.05%	0.25%	1.00%
Corn, yellow	55.93	56.93	56.88	56.68	55.93
Soybean meal, dehulled	29.10	29.10	29.10	29.10	29.10
Botanical	0.00	0.00	0.05	0.25	1.00
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 goldenseal on pig performance

Goldenseal	Control	0.00%	0.05%	0.25%	1.00%
Week 1					
ADG, lb [a]	0.26	0.18	0.20	0.24	0.22
ADF, lb [b]	0.42	0.44	0.48	0.46	0.44
F/G [c]	1.60	7.14	3.62	1.96	2.22
Week 0–2					
ADG, lb [ad]	0.59	0.46	0.48	0.48	0.46
ADF, lb [e]	0.86	0.79	0.73	0.75	0.73
F/G [f]	1.22	1.85	1.89	1.61	1.70
Week 0–3					
ADG, lb [g]	0.70	0.57	0.53	0.62	0.57
ADF, lb [ahi]	1.12	1.03	0.95	0.99	0.95
F/G [jk]	1.38	1.92	2.09	1.66	1.69
Week 0–4					
ADG, lb [fl]	0.81	0.70	0.68	0.73	0.73
ADF, lb [e]	1.32	1.23	1.17	1.19	1.17
F/G [fm]	1.46	1.88	2.00	1.65	1.63

[a] Control vs. 0.00%, P<.05
[b] Control vs. 0.05%, P<.10
[c] Control vs. 0.00%, P<.10
[d] Control vs. 0.05, 0.25 & 1.00%, P<.10
[e] Control vs. 0.05, 0.25 & 1.00%, P<.05
[f] Control vs. 0.00 & 0.05%, P<.05
[g] Control vs. 0.00, 0.05 & 1.00%, P<.01; Control vs. 0.25%, P<.05
[h] Control vs. 0.05, 0.25 & 1.00%, P<.001
[i] 0.00% vs. 0.05 & 1.00%, P<.10
[j] Control vs. 0.00 & 0.05%, P<.01
[k] 0.05% vs. 0.25 & 1.00%, P<.05
[l] Control vs. 0.25 & 1.00%, P<.10
[m] 0.05% vs. 0.25 & 1.00%, P<.10

Table 3. Effect of goldenseal on pig muscle

Goldenseal	0.00%	0.05%	0.25%	1.00%
pH	5.69	5.85	5.75	5.79
Cooking loss, %	24.46	27.33	26.39	30.14
Flavor score	1.00	1.00	1.00	1.00
Off-flavor score	6.00	2.33	3.66	4.00
Off-flavors	Sour Livery	Sour Livery	Sour Livery	Sour Livery
Hunter Lab L*	53.8	51.4	52.9	51.2

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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