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Botanicals as part of an integrated value-added pork production system

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Botanicals as part of an integrated value-added pork production system

Abstract
Some herbs are known to exhibit natural antimicrobial activity and other characteristics that could be useful in value-added animal production. Four botanical products were tested for possible inclusion in swine feeds as alternatives to synthetic chemotherapeutic and antimicrobial agents.

Keywords
Animal Science, Veterinary Medicine, Hoops and alternative livestock systems, Niche meat, dairy and poultry

Disciplines
Agriculture | Animal Sciences | Large or Food Animal and Equine Medicine
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Abstract: Some herbs are known to exhibit natural antimicrobial activity and other characteristics that could be useful in value-added animal production. Four botanical products were tested for possible inclusion in swine feeds as alternatives to synthetic chemotherapeutic and antimicrobial agents.

Background

In recent years, synthetic chemicals have supplanted traditional herbal remedies used to treat and prevent infectious diseases. Medical concerns are growing about significant antibiotic-resistant bacterial development because of the use of human drugs in animals and subsequent transfer of resistance to human pathogens. Using herbs in animal feeds as alternative growth promotion and efficiency-stimulating strategies can address some of these concerns.

Four botanical products were included in swine feeds based on their pharmacological and agronomic characteristics that make them acceptable for use in Iowa.

Echinacea (purple coneflower) grows throughout the midwestern United States. Two of the nine species are most commonly considered for medicinal purposes. The whole plant, including aerial portions and taproots, has been utilized. In Germany, echinacea has been used to treat respiratory and urinary tract infections and topically for improved healing of wounds.

Garlic, a member of the lily family, is a perennial plant cultivated worldwide. Garlic bulbs, either fresh or dehydrated, are used for medicinal purposes. Volatile oils in the bulbs are alleged to contain most of garlic’s pharmacological properties. Garlic demonstrates a broad-spectrum antimicrobial activity against many bacteria, viruses, parasites, and fungi.

Goldenseal, a perennial herb native to eastern North America, contains berberine, a pharmacologically active alkaloid. Berberine has demonstrated antimicrobial action against a wide range of bacteria, protozoa, and fungi.

Peppermint grows under a wide variety of conditions. The major medicinal components are the volatile oils found predominantly in the aerial portions of the plant. Peppermint and other members of the mint family have shown significant antiviral capability, including treatment of the common cold. Peppermint also inhibits microbial activity.

Approach and methods

The experiments were conducted at the Iowa State University Swine Nutrition and Management Center in temperature-controlled nursery rooms. Pigs were weaned at an average of 18 days and 6.25 kg. There were 20 or 24 pens of five pigs each, providing four to six replications of the dietary treatments. Each pig received 16 kg. of the prestarter treatment and then was switched to the starter treatment diet for the remainder of the five-week study. The positive control diet contained 45 ppm of Mecadox. Botanical treatments consisted of the same diet without Mecadox and increasing...
levels of botanicals replaced corn with the zero percent level considered to be the negative control. Pigs were weighed and feed disappearance measured weekly for five weeks.

In the first year of the study (1997), the project was completed at the end of the nursery phase. In 1999-2000, when the Echinacea, garlic, and peppermint studies were repeated, upon completion of the nursery phase, pigs were fed the standard farm grower and finisher diets. Post-nursery weights were recorded every four weeks to evaluate the long-term effects of the nursery treatments.

When appropriate, one pig at the end of the nursery phase from each botanical treatment was taken to the ISU Meat Laboratory, slaughtered, and various muscles evaluated for sensory and quality characteristics.

Results and discussion

Echinacea I At the tested inclusion levels (0, 0.1, 0.5, and 2.0 percent), no statistical advantage existed when compared with the diet containing 45 ppm Mecadox or with a negative control containing no antimicrobial or botanical inclusions. Muscle samples from Echinacea-treated pigs exhibited a slight, but not objectionable, off-flavor when compared to pigs fed non-inclusion levels. Overall, performance was similar, suggesting minimal subclinical stress during this experiment.

Echinacea II This trial evaluated lower levels than Echinacea I to reduce feed costs and potentially maintain some of the feed efficiencies observed. Mecadox or Echinacea (0, 0.10, 0.25, and 0.50 percent) replaced corn. The Mecadox diet had significantly better performance than the treatment levels of Echinacea in Weeks 0-3, 0-3, 0-4, and 0-5. The lower levels of Echinacea failed to enhance performance.

Echinacea III The trial was initiated to explore higher additions of Echinacea (0, 1.5, and 3 percent) compared with Mecadox (45 ppm). There were few treatment differences. However, from weeks 0 to 3 in the nursery there was a quadratic response (P<.01) to the Echinacea levels, with poorer efficiency on the 1.5 percentage level and performance on the 3 percent level equal to the performance of the positive control Mecadox-fed pigs (Table 1). Weeks 0 to 5 indicated a quadratic response to Echinacea additions in daily feed and daily gain, with the 1.5 percent level reducing per-
formance and the 0 and 3 percent levels similar to the Mecadox treatment (Table 2). No significant responses were observed post-nursery (P=.06), although pigs fed the 3 percent level of Echinacea while in the nursery had post-nursery performance equal to or slightly greater than when Mecadox was in the nursery diet (Table 3).

**Garlic I** At the tested garlic inclusions (0, 0.5, 2.5, and 5 percent), increasing levels of garlic generally depressed feed intake and average daily gain in nursery pigs, and inhibited performance compared to the Mecadox diet. Muscle samples from all slaughtered pigs had “very objectionable” or “extremely objectionable” off-flavors. This suggests that the garlic odor was sufficiently strong in the room that it also flavored muscle samples of pigs not fed garlic. The overall summary, Week 0-5, indicated that the Mecadox diet significantly improved daily gain compared to the garlic treatments; and generally the higher the level of garlic, the poorer the daily gain.

**Garlic II** The second garlic trial fed inclusion levels of 0, 0.10, 0.25, and 0.50 percent garlic, levels that might be low enough not to depress performance or alter meat flavors. Based upon the results of this study and the 1997 effort, pigs fed diets with Mecadox performed better. The addition of garlic did not enhance pig performance. At the end of the nursery phase, a slight garlic flavor was detected in muscle, but after two weeks on a garlic-free diet, no garlic flavor was detected.

**Goldenseal I** This study evaluated four levels of goldenseal (0.0 to 1.0 percent) compared to a diet containing Mecadox. Mecadox-fed pigs generally performed statistically better than the other treatments. Increasing levels of goldenseal did not influence the muscle characteristics evaluated.

**Peppermint I** Nursery pigs fed inclusion levels of peppermint (0, 0.5, 2.5, and 5.0 percent) failed to respond to added levels of the herbal supplement. Pigs on all treatments (including the Mecadox and 0 percent peppermint) performed similarly over the entire experimental period. No statistical differences were observed after the first two weeks.

**Peppermint II** Mecadox and 0, 0.5, and 1.0 percent peppermint inclusion levels under a similar feeding regimen, plus a 12-week post-nursery evaluation, were observed to determine any carry-over effects. Peppermint failed to elicit a positive response in nursery pigs, and those pigs performed less well statistically when compared to the Mecadox-fed pigs. Under the conditions of this experiment, peppermint (as in Peppermint I) was not an effective addition to swine nursery diets.

**Conclusions**

Echinacea offered the most potential of the botanicals tested. The final study fed up to 3 percent Echinacea and that level resulted in performances similar to Mecadox after three weeks on the study. By the 12-week post-nursery phase, no differences were present among any of the nursery treatments.

Garlic at high (5 percent) levels depressed performance and caused an off-flavor in the meat of all pigs sampled, even those not fed garlic but housed in the same room. Feeding up to 0.5 percent garlic resulted in depressed performance when compared to Mecadox.

Goldenseal at levels up to 1 percent resulted in depressed performance when compared to Mecadox. It also is extremely costly, at $69/lb. in October 2000. (This is compared to the prices of garlic at $5/lb., peppermint leaf at $4.50/lb., and Echinacea at $24/lb. at the same time.)

Peppermint at the 0.5 percent level in a previous study had no positive or negative effects...
on performance. In this study, feeding up to only 1 percent peppermint decreased performance when compared to Mecadox.

**Impact of results**

This data suggest that Echinacea has potential as a replacement for an antibiotic regimen given to nursery pigs reared under organic or “natural” conditions. The ISU herd used in this study was in very good health, so research under “natural” or organic farm conditions may be warranted to gauge the effects on operations with more exposure to disease factors.

**Education and outreach**

The investigators prepared seven Iowa State University Swine Research Reports on the botanicals tested in this project. They also wrote an article for Feedstuffs on inclusion of botanicals in swine diets. Results from the project were presented at the Alternative and Herbal Livestock Health Conference at Storrs, Connecticut, in October 2000.