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A Population Approach to Diagnosis of Grow-Finish Diarrhea Complex

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Summary and Implications

Because the growing-finishing phase of pig production accounts for 60 to 70 percent of the total feed costs, improvements in feed efficiency during that period can significantly effect cost-benefit potential. Alimentary tract diseases caused by bacterial agents can significantly impact the capacity of growing-finishing pigs to utilize nutrients. Although disease problems in the poultry industry are most often diagnosed by complete examination of several live animals submitted for necropsy, such an approach is cost prohibitive for growing-finishing pigs. To better control enteric bacterial diseases of growing/finishing pigs, we investigated the value of examining fecal specimens taken front a representative number of potentially exposed or infected pigs for the presence of three major enteric bacterial pathogens. We hypothesized that examining such fecal specimens would provide useful information about a farm's bacterial enteric infection status. These results indicated cost-effective control strategies aimed at enteric bacterial diseases on individual farms should be implemented. This approach also could form the basis of a surveillance program for control of bacterial agents with a public health significance.

Introduction

Although viruses are common in most body systems, diseases of the alimentary tract of growing-finishing pigs are almost exclusively caused by bacterial infections. The major known bacterial diseases affecting the alimentary tract of pigs at this stage include proliferative enteritis or "ileitis" caused by *Lawsonia intracellularis*, salmonellosis caused by *Salmonella typhimurium/agona/derby*, colonic spirochetal infections caused by *Serpulina hyodysenteriae* (swine dysentery) and *Serpulina pilosicoli*, the cause of porcine colonic spirochetosis.

Infection frequency within an animal population can be viewed as having a normal distribution with a proportion of uninfected healthy animals at one end of the spectrum and severely infected animals in the terminal stage of the disease at the other end (Figure 1). Between these two extremes sits a population of animals either exposed or infected with the agent, but may or may not show signs of disease. Traditionally, laboratory diagnosis of alimentary tract diseases of growing-finishing pigs has meant complete examination of a few severely affected or dead animals. Although this approach is highly specific and allows all possible concurrent disease problems to be identified, it is relatively insensitive because only a few animals are examined and the findings may not represent the disease affecting the at-risk population.

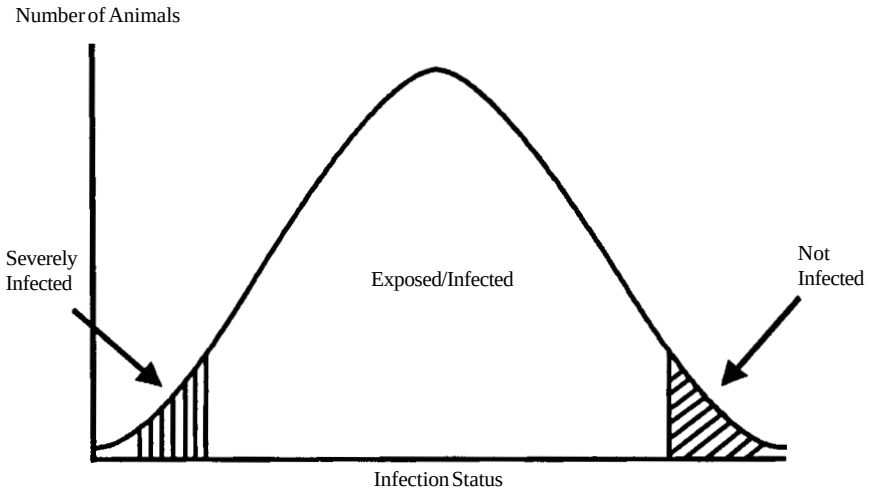

Figure 1. Normal distribution of infection frequency in a population of susceptible animals.

Table 1. Number of fecal specimens positive for the presence of bacterial agents potentially involved in diarrheal disease of growing-finishing pigs.

Farm	No. specimens examined	*Lawsonia intracellularis* (%)	Salmonellae‡ (%)	Spirochetes† WBHIS (%)	*S. pilosicoli* (%)
IA1	17	3 (17.6)	0	0	NA
ID1	15	6 (40.0)	2 (13.3)	0	NA
KS1	21	3 (14.3)	2 (9.5)	0	NA
SC1	22	1 (4.5)	2 (9.1)	2 (9.1)	2/2
OH1	18	11 (61.1)	1 (5.6)	4 (22.2)	0/4
SD1	10	3 (30.0)	0	2 (20.0)	0/2
OH2A	10	0	5 (50.0)	0	NA
OH2B	11	0	10 (90.9)	0	NA
OH2C	11	0	11 (100.0)	0	NA
OH2D	10	0	6 (60.0)	1 (10.0)	0/1
1A2	10	0	7 (70.0)	2 (20.0)	0/2
SC2	40	0	1 (2.5)	13 (32.5)	0/11
IL1	20	0	0	0	NA
SD2	9	0	0	0	NA

‡ID1, serotype unidentified; KS1, *S. agona*; SC1, *S. brandenburg*; OH1 *S. orion*; OH2, *S. typhimurium* var. *copenhagen*; IA2, serotype unidentified; SC2, *S. typhimurium* var. *copenhagen*.
†WBHIS = weakly β-hemolytic intestinal spirochetes; *S. pilosicoli*, number positive/number tested; NA = Not applicable.

Assuming an intervention strategy is available to control the infecting agent, it would be desirable to determine the infection status of the population with the highest potential benefit for treatment. To improve our ability to control enteric bacterial diseases, we investigated the value of examining fecal specimens taken from a representative number of potentially exposed or infected animals for the presence of three major enteric bacterial pathogens. We hypothesized examining fecal specimens taken from animals with clinical signs of diarrhea would provide useful information about the bacterial enteric infection status of a farm.

Materials and Methods

Between April and August 1998, 224 fecal specimens (nine to 40 per farm) were obtained from growing-finishing pigs on 14 farms with a history of diarrhea. Swabs obtained directly from the rectum of pigs with diarrhea or from fresh, undisturbed loose stools on the floor were placed in Amies transport medium with charcoal and shipped on ice by overnight courier for laboratory examination. Each specimen was processed immediately upon arrival according to a protocol for bacteriologic examination developed in our laboratory.

Results

The results of laboratory examinations are presented in Table 1. As expected, prevalence of each agent varied by farm. Mixed infections were present on four farms (ID1, KS1, SC1, OH1) and two farms had no bacterial agents identified (IL1 and SD2). *Lawsonia intracellularis* was identified on six farms; two without other significant bacterial agents (IA1 and SD1); three with Salmonellae; one with *Salmonella brandenburg* and *Serpulina pilosicoli* (SC1). Four finisher farms in Ohio had a high prevalence of *Salmonella typhimurium* var. *copenhagen* and also shared a common feed supplier and feeder pig source. Farm IA2 had a high prevalence of an unidentified Salmonellae. *Salmonella typhimurium* var. *copenhagen* was isolated from one specimen from farm SC2, but spirochetes that were different from *Serpulina pilosicoli* were isolated from 13/40 (32.5 percent) of the samples. None of the specimens yielded *Serpulina hyodysenteriae*.

Discussion

A population approach to diagnosing three major enteric bacterial diseases indicated considerable variation among farms with a history of diarrhea among growing-finishing pigs. For example, a complex of more than one bacterial agent was identified on four farms. This is likely to occur when pigs from different sources with different health and immune status, genetic background and endogenous gut flora mingle. However, at the time of sampling, one bacterial agent appeared to predominate over the others on farm ID1 and farm OH1, whereas similar prevalence of either *Lawsonia intracellularis* and *Salmonella agona* and *Lawsonia intracellularis, Salmonella brandenberg* and *Serpulina pilosicoli* were present on farm KS1 and farm SC1, respectively.

Although several farms were included in this pilot study, statistical inferences about specific bacterial agent prevalence rates could not be made. Nevertheless, about half of the farms examined had between 4.5 percent and 61.1 percent of the specimens positive for the presence of *Lawsonia intracellularis*, suggesting a high prevalence of this agent in diarrheal samples taken from growing-finishing pigs. Four finisher farms in Ohio had a high prevalence of *Salmonella typhimurium* var. *copenhagen*. These farms shared a common feed supplier and source of feeder pigs and therefore cannot be considered independent farms. By contrast, farm SC2 had only 2.5 percent of 40 specimens positive for *Salmonella typhimurium* var. *copenhagen*, making interpretation of this finding in relation to the diarrheal problem on this farm more difficult. However, one-third of the specimens collected on farm SC2 also had spirochetes different from *Serpulina pilosicoli*. The high prevalence of spirochete shedding suggested a

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potential role for this organism in the disease problem on this farm. Final identification of the spirochete might reconcile the laboratory results with the clinical problem.

The results of the laboratory examinations are affected by the relative sensitivity of the various methods, the length of fecal shedding of each agent and the rate of new infections within the population. Therefore, the most commonly isolated agent might not be the one that causes the most disease. Additionally, demonstration of a bacterial agent in a fecal specimen might not be sufficient to establish a cause and effect relationship; infection might not always equal disease. In spite of these limitations, diagnosis of enteric bacterial infections in live animals can provide a basis for implementing strategic interventions to address problems in order of importance to the population at risk.

Because transmission of enteric bacterial disease agents occurs primarily through the fecal-oral route, control measures aimed at reducing environmental contamination, including sanitation and antimicrobial therapy, are most critical. By focusing diagnostic efforts on the population with the highest benefit potential for treatment, it is possible to maximize the return on diagnostic investment. However, mixed infections are expected to cause more severe disease problems and have prolonged recovery with more variable response to therapy than single infections.

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