

Pork Producers' Cost Estimates of On-Farm *Salmonella* Testing

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Abstract

As foodborne diseases caused by pathogenic bacteria such as *Salmonella* and *E. coli* O157:H7 are increasingly publicized and new technologies become available to monitor and control these bacteria, consumers are demanding more food safety assurances, not only during slaughter, processing, and preparation, but also at the farm level where production occurs. Pork producers in Kansas and Indiana were surveyed to determine their attitudes regarding on-farm *Salmonella* testing and to provide estimates of the costs of collecting hide, fecal, or blood samples from live pigs. Veterinarians and the Cooperative Extension Service were most frequently cited as the most preferred source for monitoring and verification. Results of the survey indicate that pork producers may be willing to conduct on-farm *Salmonella* testing if they can recover the costs of sample collection. The costs ranged from \$1.48 to \$4.72 per pig, depending on the method of sample collection.

Introduction

Meat safety is accomplished through an integrated systems approach which links on-farm production, slaughter, processing, and food preparation. Although the current system is coordinated fairly well, a failure at any level of the food chain could introduce risks and hazards. Previous research has examined consumers' willingness-to-pay for technologies or practices that reduce the potential for a particular risk to occur at a specific point of the food chain.

Bruhn et al. (1) found that 77 percent of consumers surveyed had food safety concerns and over half of them indicated that they had changed their buying practices as a result. Consumers were willing-to-pay \$5.88 per household to shop in supermarkets that reject all fresh produce with detectable pesticide residues in a study by Buzby et al. (2). Hayes et al. (3) found that Iowa State University students were willing-to-pay between \$0.42 and \$0.86 more for a meat sandwich that was screened for a particular pathogenic bacteria (e.g., *Salmonella*, *Campylobacter*, *Staphylococcus aureus*, *Trichinella spiralis*, *Clostridium perfringens*). Shin et al. (4) reported that student participants would pay 55 cents per meal to avoid *Salmonella*. If consumers have no preference regarding how food safety is increased, their demand for safety should be fulfilled using the most

effective and efficient means throughout the production, slaughter, processing, and food preparation chain. This requires determining both the relative effectiveness and costs of safety enhancements at each of these levels.

Little research has focused on pork producers' willingness and ability to perform specific on-farm production practices designed to decrease the incidence of foodborne illnesses caused by pathogenic bacteria. This is likely because producers generally will comply with consumers' demands for a particular production practice, provided the market incentive to do so is sufficiently large to offset the cost. However, when the production practice has uncertain costs (and benefits) and can be performed in various ways, it is necessary to explore producers' attitudes towards implementing the production practice, as well as the costs of the practice.

The objective of this research is to measure pork producers' attitudes and costs of developing an on-farm *Salmonella* testing program. Such a program could include producer decisions and practices that could potentially influence the food safety assurance process throughout the food chain. The intent of an on-farm *Salmonella* testing program is to decrease the risk of foodborne illnesses caused by *Salmonella* by reducing the incidence at the farm level. By testing part of the swine herd, producers can monitor the *Salmonella* level and implement production practices that reduce the incidence in the entire herd.

Materials and Methods

In USDA's National Animal Health Monitoring System (NAHMS) study, nearly two-thirds of the swine operations in Missouri, Kentucky, Tennessee, North Carolina, and Georgia tested positive for *Salmonella*. The rate was lower in the Midwestern states of South Dakota, Nebraska, Kansas, Minnesota, Iowa, and Illinois (29.9 percent) and the North Central states of Wisconsin, Michigan, Indiana, Ohio, and Pennsylvania (36.1 percent). That study also found that 57 percent of operations that market more than 10,000 pigs annually were *Salmonella* positive, compared to less than 30 percent of operations marketing less than 2,500 pigs annually (5).

McKean et al. (6) monitored *Salmonella* on a commercial 680-sow farrow-to-finish operation throughout the growing phase of one group of pigs during summer and another during winter. In the first group, 90 percent of the pigs were serologically positive at one week of age. This declined to 15 percent by nine weeks of age and increased to 52 percent by slaughter weight. In the second group of pigs, 84 percent were serologically positive at one week of age. This dropped to 12 percent by nine weeks of age and rose to 21 percent by slaughter weight. The Food Safety and Inspection Service (FSIS) (7) reported that the average incidence of *Salmonella* on hog carcasses was 8.7 percent. The prevalence of *Salmonella* on pigs, therefore, can be significant as they leave the farm. To determine whether safety enhancement at the farm level is cost effective relative to other intervention points, the costs of testing for the amount of *Salmonella* at the farm must be determined.

Various types of on-farm testing may be used to detect the presence of *Salmonella* and the costs are likely to differ for each based upon the pork producers' facilities and labor availability. Pork producers' decision to participate in an on-farm *Salmonella* testing program will not only be influenced by the costs of collecting samples from their swine herd, but also will be a function of their belief that the program will in fact reduce the prevalence of pathogens in the pork supply, their willingness to work with those administering the program, and their familiarity with foodborne pathogens.

Pork producers in Indiana and Kansas were surveyed to determine the costs of collecting samples for *Salmonella* testing (8). The Indiana survey population was sixty members of an Indiana pork marketing cooperative that has coordinated their pork production by contracting slaughter and direct marketing their pork. Two-hundred and ninety members of the Kansas Pork Producers' Council comprised the Kansas survey population. We choose the Indiana sample because producer involvement through a cooperative may be an effective method to initiate a coordinated system. In Kansas, Farmland Industries has announced their intentions of pursuing such a system through an alliance with private firms and land grant universities. Many of these producers market their hogs through Farmland's plants. Producers were first asked to categorize their major pork production process (breeding, feeder pig, farrow-to-finish, etc.) and the number of pigs involved in that process because each can influence the level of *Salmonella* present on the production site.

The pork industry was the first livestock industry to proactively attempt to implement a voluntary quality assurance program. Producers can complete three levels of the Pork Quality Assurance (PQA) program. To complete the first level of PQA, producers must keep records of animal health care products used. The second level requires that producers complete a self-review of PQA I. To complete the third level, producers must complete a check-

list of production practices biannually. The second and third levels require producers to be certified by a veterinarian or extension agent. The PQA system was widely adopted as several packers paid producers \$1/head to encourage adoption. Most packers required that pork producers become certified PQA III by January 1, 1999, or they would no longer purchase their animals. Because pork producers have some experience with voluntary quality programs, the survey respondents were asked to indicate the highest level of the PQA program that they have completed.

An on-farm *Salmonella* testing program would likely require monitoring or verification of sampling and testing information. Additionally, these records might be linked with slaughter and processing records to develop a consumer-to-producer traceback system and to promote pathogen-reduced pork. Therefore, survey respondents were asked whether they preferred veterinarians, the Food Safety and Inspection Service (FSIS), the Cooperative Extension Service, the Animal and Plant Health Inspection Service (APHIS), private consultants, or scientists employed by the slaughter plant to conduct this monitoring and verification.

The respondents' attitudes about food safety and their willingness to participate in on-farm tasks designed to increase food safety were also examined. Specifically, the pork producers were asked how important pork product safety is, the degree to which they believe they can improve pork product safety, their willingness to change their production process, and what they believe the advantages and disadvantages to on-farm *Salmonella* testing are.

Within the survey, on-farm *Salmonella* reduction was described before producers were asked to estimate the costs of collecting samples to be tested for *Salmonella*. Three versions of the survey differed in how the method of sample collection was described. One version described the procedure for collecting a fecal sample as restraining the pig and collecting a feces sample from the rectum. The second version of the survey described the blood sampling procedure as restraining the pig and drawing a blood sample from the neck. The third version of the survey described hide sampling, wherein a sterile gauze or sponge is wiped against the pig's hide.

Testing a hide sample for *Salmonella* indicates if the pig has been exposed to feces. Blood samples are tested to determine if the pig is producing an immune response to disease. A fecal sample test measures exposure to disease or the amount of *Salmonella* being shed by the pig. Because one of the main goals of the pre- and post-harvest Hazard Analysis and Critical Control Points (HACCP) program is to reduce the amount of fecal contamination on pigs and carcasses, testing hide samples (rather than fecal or blood samples) for pathogenic *Salmonella* would most closely meet this goal.

After the on-farm pathogen testing procedure (either fecal, blood, or hide) was explained, the respondents were asked to estimate the cost of collecting that type of sample from five pigs in a pen. Producers were instructed that the samples would be sent to a testing laboratory after they were collected from the pigs. Therefore, the costs that producers were asked to estimate reflect increased labor, facilities, and management expenses, not the laboratory costs of analyzing the sample for bacteria. The cost estimates based on five pigs in a pen were converted to a dollars per pig basis using the assumption that one pen contained twenty pigs (9).

Results

The response rate for the surveys sent to the Indiana producers was 68.3 percent. Fifteen fecal, thirteen blood, and thirteen hide versions of the surveys were returned from the Indiana survey population. Twenty-four percent of the Kansas survey population returned the survey. Thirty-eight fecal, twenty blood, and eleven hide versions of the surveys were received.

Demographic Information

Table 1 summarizes the demographic information for each of the three survey versions for both the Indiana and Kansas survey population. All of the Indiana respondents and

nearly all of the Kansas respondents were males. The mean age of the Indiana and Kansas respondents were not significantly different from each other. The Indiana producers tended to have one family employee involved in the pork operation whereas the Kansas producers had two family members employed in the pork operation. Approximately 85 percent of the Indiana producers had completed PQA Level III certification relative to about 78 percent of the Kansas producers.

The Indiana producers did not report sales of breeding stock, feeder pigs, or early-weaned pigs, which is congruent with the purpose of their marketing cooperative. The mean number of pigs sold annually from farrow-to-finish and finishing pig operations ranged between 775 and 1171 head (Table 1). Sales were not statistically different across the fecal, blood, and hide versions of the survey. The Kansas producers reported higher annual sales than did the Indiana producers, averaging 9,975 head. This significant difference is likely because the Kansas survey population included all types and sizes of pork operations whereas the Indiana survey population was limited to members of the marketing cooperative. Kansas producers indicated sales of breeding stock, feeder pigs, and early-weaned pigs because they were not exclusively members of a vertically coordinated cooperative. The number of pigs the Kansas and Indiana farrow-to-finish and finishing pig producers sold annually were statistically different at the 0.05 level.

	Indiana Producers			Kansas Producers		
	Fecal Version	Blood Version	Hide Version	Fecal Version	Blood Version	Hide Version
Number	15	13	13	38	20	11
Gender, % male	100	100	100	94.7	95	100
Age, years	42.8	41.4	46.0	44.3	46.5	43.1
Family Employees, number	1.1	1.3	1.0	2.3	2.3	2.0
PQA Certification						
Level I, %	0.0	0.0	0.0	7.9	10.0	0.0
Level II, %	13.3	15.4	15.4	7.9	10.0	9.1
Level III, %	86.7	84.6	84.6	76.3	70.0	90.9
No response, %	0.0	0.0	0.0	7.9	10.0	0.0
Breeding Stock Sold Annually	0	0	0	13,000	67,367	12,650
Feeder Pigs Sold Annually	0	0	0	10,723	0	0
Early-Weaned Pigs Sold Annually	0	0	0	10,500	30,500	12,000
Market Pigs Sold Annually from Farrow-to-Finish Operations	815	1171	775	4,763	5,111	12,500
Market Pigs Sold Annually from Finishing Pig Operations	912	1,029	910	4,489	6,200	8,700

Program Monitoring Information

Figure 1 illustrates the producers' preference for groups to conduct verification and monitoring of an on-farm *Salmonella* testing program. Veterinarians and Cooperative Extension Service (CES) personnel were most preferred, with Indiana producers rating these groups statistically higher than did the Kansas producers. For both the Kansas and Indiana producers, USDA personnel from either APHIS or FSIS were much less preferred to conduct the verification activities. Kansas producers indicated significantly higher levels of preference for private consultants and slaughter plant scientists than did Indiana producers. This reinforces a study reported by NAHMS which found that veterinarians and the CES were primary sources of information for producers (10).

Figure 2 shows that all the Kansas producers believe that the safety of pork products is at least a "Moderately Important" issue, and nearly 15% thought that it is a "Very Important" issue. Although approximately 3% of Indiana producers did not rate the safety of pork products as at least moderately important, nearly 40% of them viewed pork product safety as very important.

Not only do pork producers believe the safety of pork products is an important issue, but many also believe that they can improve the safety of pork products on the farm. Figure 3 shows that 35% of Kansas and Indiana producers believe that on-farm activities can "Greatly Increase" pork product safety. However, over 60% of producers believe that they can only "Marginally Contribute" to pork product safety. In fact, 5% of the Kansas producers felt that they

would have "Little Effect." Although many producers stated that they could only marginally contribute to pork product safety, all respondents indicated that they would comply with requests from slaughter plants for changes in their production process, for example, increasing the withdrawal period for injectable pharmaceuticals prior to slaughter. All of the Indiana producers indicated that they would expect a premium for their pigs for compliance with such a request. Only about 60 percent of the Kansas producers indicated that they would expect a premium for compliance, while the remaining 40 percent were willing to comply without a premium.

Knowledge of Program Information

Producers were asked to describe their knowledge of on-farm *Salmonella* testing. All the Indiana producers indicated that they had either never heard about on-farm *Salmonella* testing or knew very little about it. The Kansas producers responded similarly, with only 10 Kansas producers claiming to know a lot about on-farm *Salmonella* testing. All the Indiana producers and the majority of the Kansas producers indicated that most of their previous knowledge about on-farm pathogen testing was obtained from producer trade magazines and newspapers.

After reading the statement describing on-farm *Salmonella* testing, producers were asked to select from among six options the one they believe to be the single greatest benefit to on-farm *Salmonella* reduction. Over 50% of the Kansas producers identified safer pork products as the greatest benefit of on-farm pathogen reduction, compared to less

Figure 1. Preferences for Verification and Monitoring

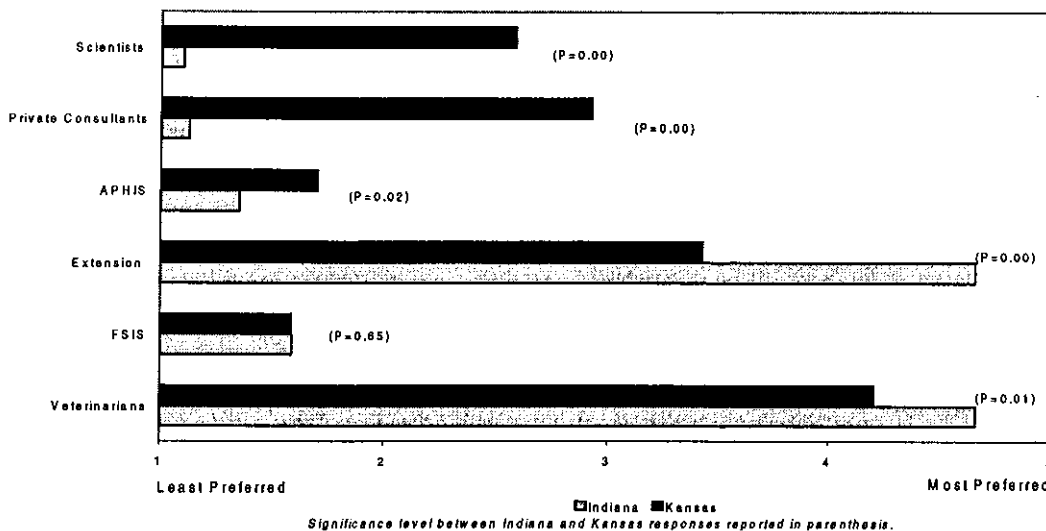


Figure 2. Degree of Importance of Pork Product Safety

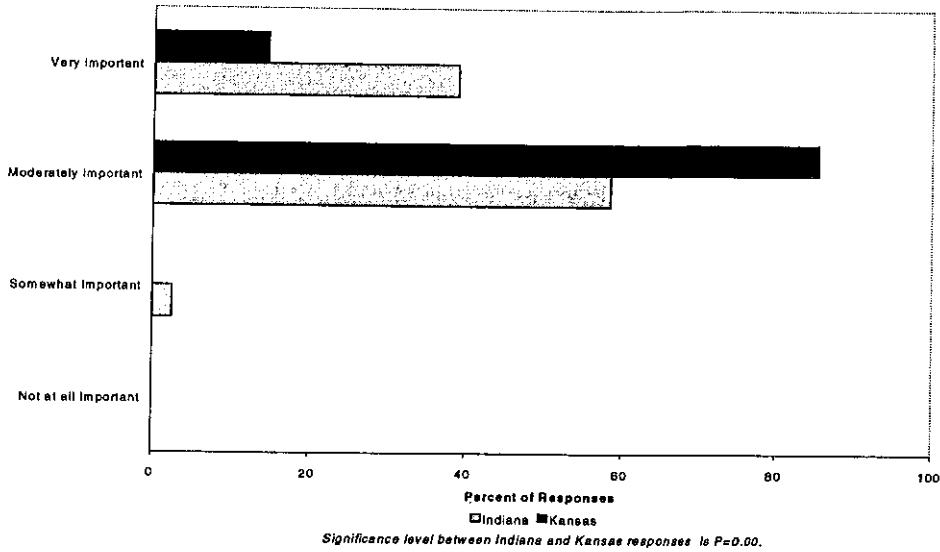


Figure 3. Ability to Improve Pork Product Safety on the Farm

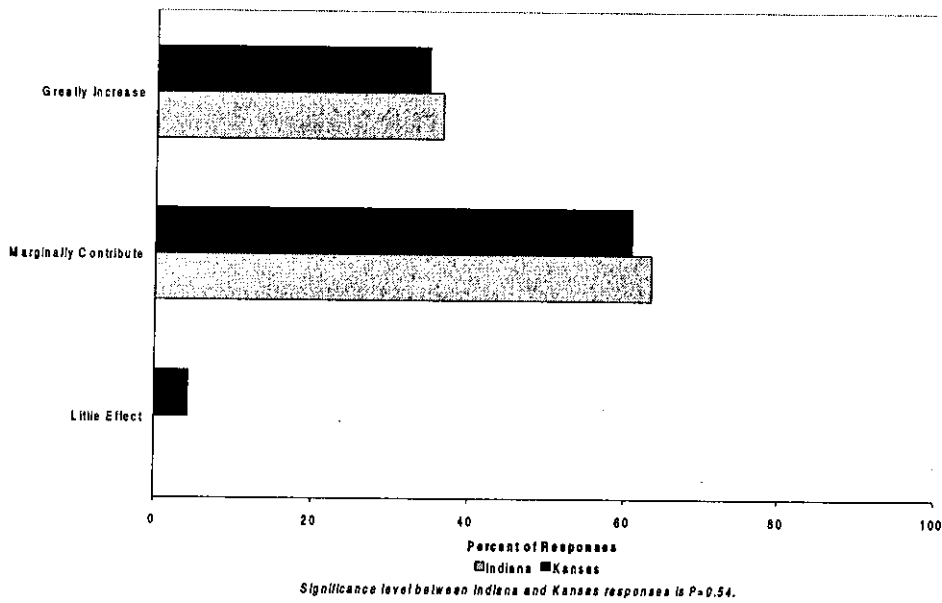


Figure 4. Greatest Advantage of On-farm Salmonella Testing

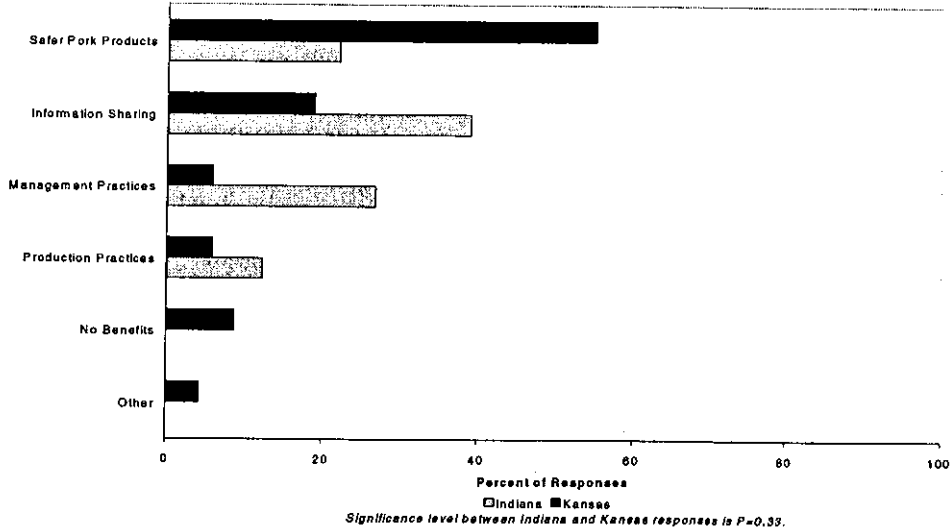


Figure 5. Greatest Disadvantage of On-farm Salmonella Testing

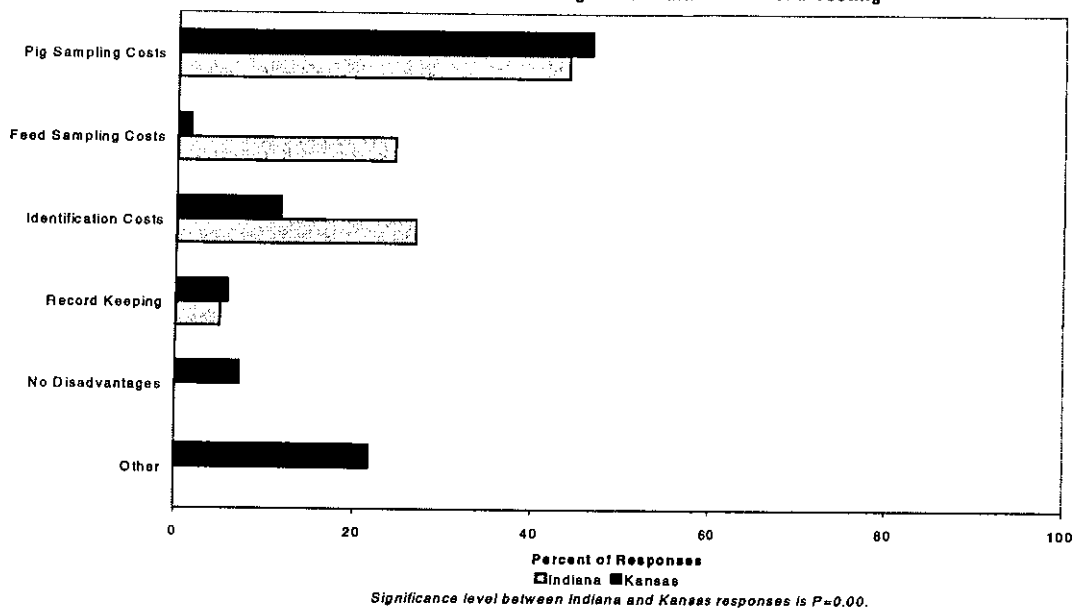
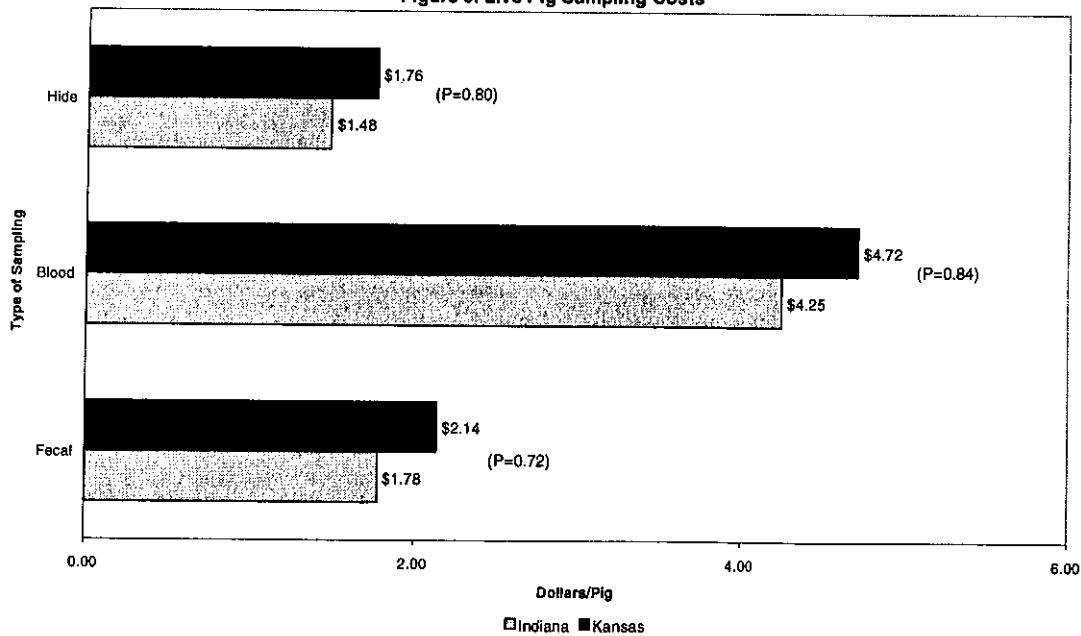


Figure 6. Live Pig Sampling Costs



Significance level between Indiana and Kansas responses reported in parenthesis. No statistical difference between types of sampling for Kansas responses. Blood sampling was statistically different ($P=0.00$) from hide and fecal sampling for Indiana responses.

than 25% of the Indiana producers (Figure 4). The Indiana producers tended to place more importance on information sharing, management practices, and production practices than did the Kansas producers, which is likely a result of their current relationship with the vertically coordinated marketing cooperative. Nearly 10% of the Kansas producers reported no benefits to an on-farm *Salmonella* reduction program. The Indiana and Kansas responses were not statistically different.

Over 40% of the Kansas and Indiana producers identified live pig sampling costs to be the greatest disadvantage to an on-farm pathogen reduction program (Figure 5). Between 20% and 25% of the Indiana producers indicated that feed sampling costs and identification and traceback costs would be the greatest disadvantage (testing feed for *Salmonella* was mentioned in the survey's description of pathogen reduction). Fewer Kansas producers identified feed sampling, animal identification, or record keeping as the greatest disadvantage to on-farm pathogen reduction, citing other disadvantages such as inconvenience and time.

Program Cost Estimates

Kansas producers estimated the costs for collecting hide, fecal, and blood samples to be \$1.76 per pig, \$2.14 per pig, and \$4.72 per pig, respectively (Figure 6). The differences in the costs for the three methods of sampling were not statistically different. Indiana producers estimated the costs for collecting hide, fecal, and blood samples to be \$1.48 per pig, \$1.78 per pig, and \$4.25 per pig, respectively. The Indiana producers' fecal and hide sampling costs were not statistically different. Indiana producers' blood sampling cost estimates were statistically different from fecal and hide sampling costs. The Kansas and Indiana responses were not statistically different.

Discussion

Although the pork producers generally indicated a willingness to participate in on-farm *Salmonella* testing if they were compensated for doing so, few of the producers possessed a substantial knowledge of on-farm *Salmonella* testing. Therefore, if on-farm *Salmonella* testing is to be adopted, more education is needed. Because most of the producers indicated that what knowledge they did have regarding on-farm *Salmonella* testing came from producer trade magazines and newspapers, these media forms will likely be most effective in further educational efforts. Pork producers preference for veterinarians and the CES to conduct verification and monitoring of an on-farm *Salmonella* testing program suggest that these groups would be favorable choices to develop and conduct an education program. Future research must determine if consumers value on-farm *Salmonella* testing enough to provide the market incentive for pork producers to implement on-farm *Salmonella* testing of their pigs and if it will significantly contribute to reducing *Salmonella* in the pork supply.

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