I. "Group Relationship of Salmonella ELISA Antibody Status of Grower-Finisher Hogs to Fecal Shedding Detectable by Culture," #98-149.

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II. ABSTRACT:

From July 1998 through November 1999, 15 groups of 30 pigs (450 total) were randomly picked (each total group size = 185 pigs), double ear-tagged, individually fecal and blood sampled, and placed into one of 5 separate finishing facilities (3 groups per facility) within a vertically integrated pork production system. Fecal and blood sampling was continued on individually identified animals at approximate monthly intervals for 3 or 4 times with the last pre-harvest samples being collected 2 to 18 days prior to slaughter (9 day average). All groups of hogs remained on full feed until loaded for shipment. Transportation time and methods, separation of hog groups during transit and at the packer, and lairage were approximately the same for all groups. Ileocecal lymph nodes and cecal/rectal combined fecal samples were collected at slaughter from individually identified hogs. Sera was tested by the MIX-ELISA test for Salmonella antibodies and fecal and cecal/rectal fecal samples were cultured for Salmonella, serogrouped, and sent to NVSL for serotyping.

Objective 1 was to compare the development of Salmonella ELISA antibody with fecal shedding of Salmonella in each group as they were sampled at monthly intervals pre-harvest. **Groups started as relatively "Salmonella clean"** by **ELISA and culture** on **individual animal testing** and then **remained similar** or **varied greatly** on **subsequent monthly pre-harvest ELISA and culture samples. 181/234 (77%) ELISA pos 1 to 3 times were culture neg at all samples pre-harvest. 39/205 (19%) ELISA neg on all samples were culture pos on 1 to 3 samples pre-harvest; common B serogroup were represented in these ELISA False Neg Results pre-harvest. B, E1, C2, C1, K, and L serogroups were represented in ELISA pos/culture pos serotype results reported to date. 110 isolates were cultured from 88 hogs pre-harvest and 262 isolates were cultured from 201 hogs at slaughter (2.3X more pos hogs and 2.4X more**

isolates at slaughter versus pre-harvest, respectively).

ADG data was available on 13/15 groups. There was **NO WITHIN GROUP SIGNIFICANT DIFFERENCE in ADG** between culture pos alone **(PC)**, ELISA pos alone **(PE)**, pos culture/pos ELISA **(PCPE)**, and neg culture/neg ELISA **(N)** animals in **12/13 groups.** The exception, Group #3 C, had a SIGNIFICANTLY HIGHER ADG in PE animals (P = 0.03), but NON-SIGNIFICANT DIFFERENCE (NSD) using Duncan's test (P = 0.05). **When all ADG data was pooled and analyzed,** there was **NSD (P = 0.64) between groups PC** = 1.34 lbs, **PE** = 1.40 lbs, **PCPE** = 1.41 lbs, and **N** = 1.38 lbs. **There was NO STATISTICALLY SIGNIFICANT REDUCTION in ADG by PC, PE, or PCPE.**

All individual and group pre-harvest and slaughter data was given the following designations: A = pre-slaughter fecal culture; B = slaughter cecal/rectal fecal culture; C = pre-slaughter ELISA; D = slaughter lymph node culture; E = any fecal culture pre-harvest; F = any ELISA pre-harvest, and 11 STATISTICAL COMPARISONS MADE. Results were: A to B (P = 0.15); C to D (P = 0.44); E to B (P = 0.07); F to D (P = 0.04); A to C (P = 0.56); A to D (P = 0.17); B to C (P = 0.21); B to D (P < 0.0001); E to F (P = 0.96); B to F (P = 0.91); and E to D (P = 0.17). THESE STATISTICAL RESULTS WERE USED TO REINFORCE NON-STATISTICAL MEASUREMENTS USED FOR OBJECTIVES 2 AND 3 AND TO VALIDATE OBJECTIVE 1 FINDINGS.

Objective 2 was to compare **pre-harvest Salmonella ELISA antibody to slaughter culture of lymph nodes. Using the non-statistical criteria described in PROCEDURES, there was NO INDIVIDUAL ANIMAL CORRELATION between ELISA pos at sampling immediately pre-harvest and slaughter lymph node culture in 13/15 (87%) of groups, and NO GROUP CORRELATION between these same pre- and post-harvest tests in 8/15 (53%) of groups. Statistical analysis comparing these same tests was NON SIGNIFICANT (P = 0.44, comparison C to D). The value of any pos of multiple ELISA tests pre-harvest to predict pos lymph node culture at slaughter TRENDED TO BE SIGNIFICANT (P = 0.04, comparison F to D).**

Objective 3 was to compare **pre-harvest fecal culture** for Salmonella to **slaughter cecal/rectal combined fecal culture. Using non-statistical criteria, there was NO INDIVIDUAL CORRELATION between fecal culture pos at the last sampling pre-harvest and slaughter**

cecal/rectal combined fecal culture pos in 14/15 (93%) of groups, and NO GROUP CORRELATION between these pre- and post-harvest tests in 10/15 (67%) of groups. Statistical analysis showed the value of an immediate pre-slaughter pos fecal culture to predict pos cecal/rectal combined fecal culture at slaughter was NOT SIGNIFICANT (P = 0.15, comparison A to B). The value of any pos of multiple fecal cultures pre-harvest to predict slaughter cecal/rectal fecal pos culture was improved but NOT SIGNIFICANT (P = 0.07, comparison E to B).

Statistical analysis of the value of pos cecal/rectal pos culture at slaughter to predict pos lymph node culture at slaughter was HIGHLY SIGNIFICANT (P < 0.0001, comparison B to D).

Data on these 15 groups demonstrate there is NO SIGNIFICANT STATISTICAL DIFFERENCE and NO POS NON-STATISTICAL CORRELATION between immediate pre-slaughter ELISA compared to slaughter lymph node culture, and pre-slaughter fecal culture compared to cecal/rectal culture (tests 2 to 18 days apart [9 day average]). There was improvement in correlation when these same tests used multiple times pre-harvest were compared to respective slaughter tests, however, multiple tests are not practical. THE LACK OF CORRELATION BETWEEN IMMEDIATE PRE- AND POST-HARVEST TESTS, THE HIGHLY SIGNIFICANT CORRELATION BETWEEN CECAL/RECTAL FECAL AND LYMPH NODE CULTURE AT SLAUGHTER, AND THE 2.4X HIGHER NUMBER OF S. ISOLATES AT SLAUGHTER VS. ALL SAMPLES PRE-HARVEST DEMONSTRATE EVIDENCE FOR SALMONELLA CONTAMINATION OF LIVE HOGS AT THE SLAUGHTER FACILITY AND/OR IN TRANSIT, AFTER HOGS EXIT THE FARM. Note that feeding practices before transport, transportation times and methods, separation of hog groups during transit and at the packer, and lairage were about the same for all groups (exceptions noted in Conclusions). The group relationship of fecal culture immediately pre-slaughter to cecal/rectal fecal culture at slaughter and immediate pre-slaughter ELISA to slaughter lymph node culture was pos correlated by non-statistical methodology (15% or less variation) in 5/15 (33%) and 7/15 (47%) of groups, respectively, even though there was no statistical significant correlation. Therefore, transportation and lairage stress as a cause of Salmonella shedding and contamination of live hogs after exiting the farm did not seem to be important in these groups, which were in the minority.

THESE DATA SHOW A DISTURBING DIFFERENCE BETWEEN THE SALMONELLA PRE-SLAUGHTER STATUS OF HOGS ON THE FARM AND THEIR STATUS AT THE PACKER AFTER SLAUGHTER.

THESE DATA DEMONSTRATE THAT ON THE FARM, PRE-HARVEST ASSESSMENT OF THE SALMONELLA STATUS OF GROUPS OF HOGS 2 TO 18 DAYS (9 DAY AVERAGE) PRIOR TO SLAUGHTER MINIMIZED THE CONFOUNDING VARIABLES INTRODUCED WHEN PREDICTION OF THE IMMEDIATE PRE-HARVEST SALMONELLA STATUS WAS ATTEMPTED AT SLAUGHTER.

Because of 19% false neg ELISA results, 77% ELISA pos/culture neg results (28% ELISA pos on 2 to 4 tests/culture neg), and the apparent lack of activation of the immune system to produce antibody by Salmonella infection, as shown by no reduction in ADG in all groups of PC, PE or PCPE hogs, THESE DATA SEEM TO INDICATE THAT ELISA DOES NOT PROVIDE ENOUGH INFORMATION ABOUT THE SALMONELLA STATUS OF HOGS ON THE FARM, PRE-SLAUGHTER, TO BE USED IN A PRE-HARVEST CERTIFICATION PROGRAM.

Considering that ELISA is designed to measure persistent antibody after Salmonella infection, and immediate pre-slaughter ELISA samples were obtained 2 to 18 days (9day average) prior to slaughter, the results of ELISA from sera or meat juice collected at slaughter and substituted for ELISA results collected from sera immediately pre-slaughter (as in this study) may be similar when compared to pre-harvest fecal culture. IN OTHER WORDS, ELISA RESULTS FROM SAMPLES AT SLAUGHTER MAY HAVE NO SIGNIFICANT CORRELATION TO FECAL CULTURE PRE-HARVEST. IF THIS IS TRUE, ELISA RESULTS FROM SLAUGHTER SAMPLES MAY BE UNRELIABLE FOR CLASSIFYING THE IMMEDIATE PRE-HARVEST SALMONELLA STATUS OF GROUPS OF FINISHER HOGS.

Group comparisons of immediate pre-slaughter pos fecal culture and pos ELISA in these 15 groups showed fecal culture and ELISA consistently (15% or less variation) classified groups of hogs relative to farms R, J, E, C, and D at 13/15 (87%) and 9/15 (60%), respectively. In a previously unpublished study on these same farms, group comparisons of

immediate pre-slaughter pos fecal culture, pos PCR, and pos ELISA in 22 groups showed fecal culture, PCR, and ELISA consistently classified groups of hogs relative to farms R, J, E, C, and D at 18/22 (82%), 18/21 (86%), and 10/20 (50%), respectively. PCR confirmed consistency of fecal culture results. ELISA was 50% consistent and had no comparison test for validation of consistent results. THESE DATA DEMONSTRATE FECAL CULTURE PRE-HARVEST GAVE THE MOST CONSISTENT ASSESSMENT OF SALMONELLA STATUS OF GROUPS OF FINISHER HOGS ON THE FARM, IMMEDIATELY PRIOR TO SLAUGHTER.

FROM DATA IN THIS STUDY IT SEEMS THAT A CLASSIFICATION SYSTEM FOR SALMONELLA STATUS OF GROUPS OF FINISHER HOGS AND EVEN THE FARMS THEY ORIGINATE FROM COULD BE BASED ON FECAL CULTURE WITHIN ONE OR TWO WEEKS PRIOR TO SLAUGHTER. THE COST FOR CULTURE OF 30 HOGS, NOT COUNTING PROFESSIONAL FEE OR LABOR, MILEAGE, COLLECTION CONTAINERS, SAMPLE SHIPPING, AND RESULTS REPORTING WOULD BE A MINIMUM OF $150 TO $200.

III. INTRODUCTION:

Salmonella serotypes known to cause human illness are shed by clinically normal finishing hogs in the US. This shedding has been reported to occur in 6 % of all samples cultured and in 38.2% of all farms (Bush EJ, 1995). Classification of grower-finisher herds as to prevalence of Salmonella is an important step toward supplying market hogs that pose low risk to post-harvest food safety. There are currently no official classification systems in the US. Denmark has a classification program that can serve as a model but it may not be totally compatible with US production systems (Holm A, 1996). Use of the Danish MIX-ELISA test for Salmonella antibody has been compared to culture as a detection method to determine if finisher hogs are infected with Salmonella. One report concluded that these two methods were closely related in effectiveness (Baum DH, 1996). A later report concluded there was no direct correlation between serum ELISA value and culture of Salmonella in feces with both samples collected in hogs immediately prior to slaughter (Baum DH,1997). In addition to the conflicting interpretations of the relationship between ELISA and culture, ELISA has the limitation of being a herd test and not an individual animal test; a single test cannot determine if an animal is free of Salmonella or not (Blaha T, 1997). Culturing Salmonella, including enrichment/selective methods, is still the reference test or "gold standard" to compare other tests against. Culture can provide accurate results if positive and can be confirmed by serotyping, but a negative test is not reliable (Blaha, T, 1997). In the US it is not certain which current or future group of tests could best be used to monitor or classify groups of hogs as to Salmonella infection status prior to entering the food chain. Any method of classification developed in the near future will depend on currently available and practical tests such as culture and ELISA. Any method of classification should also be realistic and consider that virtually any of the over 2200 serotypes of Salmonella **could infect** grower-finisher swine, **probably will not** cause clinical signs of disease, but **will likely cause at least intermittent** fecal shedding, that **may pose** a risk of carcass contamination at the packing facility, **that might lead to a post-harvest pork safety risk** (Blaha, T, 1997). With the formulation of any classification system it should also be considered that the **total elimination** of Salmonella from pork production **is probably not possible** (Blaha T, 1997). Therefore, **important questions are: 1.) What** Salmonella **test** or **group of tests** will equitably classify groups of hogs prior to slaughter as to Salmonella exposure, infection, and shedding status in all the many styles of swine production systems in the US? **2.)** Furthermore, should such tests be preformed **late in the finishing stage** or **at slaughter** or **both**?

IV. PROJECT OBJECTIVES:

Objective 1. **Compare the development of Salmonella ELISA antibody with fecal shedding of Salmonella in groups of hogs in grower-finishers.**

Objective 2. **Compare pre-harvest serum ELISA antibody to Salmonella to post-harvest culture of Salmonella from ileoceal lymph nodes.**

Objective 3. **Compare pre-harvest fecal culture for Salmonella to post-harvest fecal culture from both the cecum and rectum.**

V. PROCEDURES:

From July 1998 through November 1, 1999, **15 separate groups** of **30 pigs** originating from Farrow-to-finish **farm E** were **double ear-tagged, fecal and blood sampled** and **transported** to grower-finisher facilities at **farms D, R, J, E, and C (farm C received two groups from farrow-to-finish farm ES and one group from farm E) .** All grower-finisher facilities except on farm D have solid-floored, modified open front housing; Farm D has a modified open front building with partially solid and partially slatted floors. The average starting weights of pigs were about 100 lbs on 4 farms and 55 lbs on farm C; each group of 30 tagged pigs represented a randomly picked sample from a total of about 185 pigs. **Fecal** and **blood sampling** was continued at approximate monthly intervals with the last sampling 2 to 18 days (9 days average) prior to slaughter. **Individual animal fecal sampling** was accomplished after observing each tagged hog defecate after snare restraint and collecting samples wearing non-sterile, disposable latex gloves, or collecting feces with a fecal loop via rectal insertion. Feces were collected into sterile plastic 50 ml tubes with screw tops. Latex gloves were changed between each collection and the fecal loop was washed completely free of feces with high pressure water after it was used. **All feces samples** were **fresh** and were **identifiable to the tagged hog from whence it came. Blood** was collected by needle and syringe from the right or left Brachiocephalic vein of the neck and the deposited into 50 ml screw top sterile plastic tubes.

Hogs **remained on full feed** till loaded into trailers. The **experimental hogs remained with their original group of 185 hogs during transit**, which took 3-6 hours depending on location. After unloading at the packing plant, the **experimental hogs with their group were penned separately until immediately prior to slaughter.** Approximately **18 to 23 hours** elapsed between leaving the farm and slaughter. **At slaughter**, tagged hogs were **sampled** for **ileocecal lymph nodes** and **feces from both the cecum and rectum. Viscera** from each tagged hog was **identified** by clipping an **ear tag** from the head to the viscera. **All tagged viscera** were **collected into clean plastic barrels** prior to sampling. Each tagged viscera was then placed on an inspection table and **ileocecal lymph nodes** were collected wearing non-sterile, disposable latex gloves and put into 50 ml sterile screw-top tubes. The same pair of gloves was worn while collecting **cecal/rectal feces. First the rectum was cut open with surgical scissors and feces removed and put into sterile 50 ml tube; then the cecum was hung off the table, cut at its lowest point, allowed to start draining, and a sample of contents was collected into the same tube as the rectal feces, lid secured, and shaken to mix the contents. The scissors and gloves were then sanitized in 180 degree water and gloves were changed before another hog's viscera was sampled**. **This routine was strictly followed so as to minimize cross-contamination between samples.**

Sera from blood samples were **tested** for **Salmonella antibody** by the **MIX-ELISA** at **NOBL Laboratories** in Ames, Iowa. **Feces** and **ileocecal lymph nodes** were **cultured for Salmonella** at the **College of Veterinary Medicine, Microbiology Laboratory** at College Station, Texas. **Salmonella isolates** were serogrouped and then sent to **National Veterinary Services Laboratory,** Ames, Iowa, for **serotyping.** A **unique** aspect of this study was that all farms routinely fed cooked food waste as a supplement the standard hog ration for various lengths of time in the finishing period.

Comparisons for objectives 2 and 3 were first performed via a non-statistical protocol where individual and group correlation were measured. For a positive individual correlation, the formula used was: # pos (pre-slaughter)/pos (post-slaughter) > # neg(pre-slaughter)/pos (post-slaughter) or # pos (pre-slaughter)/neg(post-slaughter); or if all samples pre- and post-slaughter were neg or pos there was an individual correlation. For a pos group correlation the pre-slaughter positives and post-slaughter positives had to be within 15% or less of each other; for informational purposes, groups were also classified into three categories in individual farm group results as follows: Mild (0 to < 25%), Moderate (25% to < 50%), or High (50% or >).

Data for Objectives 1, 2 and 3 were analyzed using mixed-model logistic regression in which the outcome was modeled as a function of the measurement taken at the individual pig level and accounted for the potential random effects of group in SAS System for Mixed Models (1996). Groups were given the following designations: Pre-slaughter fecal culture =A; Slaughter cecal/rectal fecal culture = B; Pre-slaughter ELISA = C; Slaughter lymph node culture = D; Any fecal culture pre-harvest = E; and Any ELISA pre-harvest = F. A to B (Objective 3), C to D (Objective 2), E to B, F to D, A to C, A to D, B to C, B to D, E to F, B to F, and E to B were compared (11 Statistical Comparisons).

The within group average daily gain (ADG) between culture pos/ELISA neg (PC), culture pos/ELISA pos (PCPE), ELISA pos/culture neg (PE), and culture neg/ELISA neg (N) were analyzed using the General Linear Model of SAS (1990) ANOVA and Duncan's Multiple Range Test. ADG Least Square Means were adjusted for starting weight and sex.

VI. RESULTS:

FARM "D, #1 Group"

7-16-98	8-17-98	9-17-98	10-21-98	10-26-98Feces	10-26-98 LN
cult = 0%	cult = 0%	cult = 3%	cult = 10%	cult = 11%	cult = 4%
0/30	0/28	1/29	3/29	3/28	1/28
ELISA = 0%	ELISA = 64%	ELISA = 0%	ELISA = 59%		
0/30	18/28	0/29	17/29		

Objective 1: 0 ELISA and culture positive at 1st sampling. 18 ELISA pos (High >50%) and 0 culture pos at 2nd sampling. 0 ELISA and one culture pos (Low 0 to <25%) at 3rd sampling. 17 ELISA pos (High >50%) and 3 culture pos (Low 0 to <25%) at 4th sampling. All 3 culture pos pre-harvest were from different animals. 11 hogs ELISA pos only one time; 12 animals ELISA pos twice; and 23 different hogs ELISA pos once or twice. **3/4 (75%) hogs culture pos pre-harvest were ELISA pos twice. 1/4 (25%) culture pos hog pre-harvest was ELISA neg at all 3 samplings (one ELISA sampling not done). 20/23 hogs (87%) ELISA pos once or twice pre-harvest were culture neg on all 4 samplings pre-harvest**. **1 hog ELISA neg on all samples was culture pos pre-harvest. 1/6 ELISA neg hogs (17%) on all samples was culture pos pre-harvest.**

Objective 2: 17 hogs were ELISA pos (High 59%) at the **4th sampling, prior to slaughter** while **one hog was lymph node pos (Low 4%) at slaughter, 5 days later**. **Therefore, ELISA pos antibody immediately pre-harvest was not individually or group correlated with lymph node culture post-harvest (there was an inverse relationship).**

Objective 3: 3 hogs had pre-harvest fecal pos cultures at 4th sampling and 3 **different** hogs had **post-harvest cecal/rectal combined pos cultures**. **Feces culture positives pre- and post-harvest were not individually correlated but the same number were pos at the 4th sampling and at post-harvest (but in different hogs), showing a group correlation**.

ADG N = 1.37 lbs PC = 1.36lbs PE = 1.28lbs PCPE = 1.41 lbs NSD (P = 0.89)

FARM "D, #2 Group"

3-3-99	4-8-99	6-7-99	6-10-99Feces	6-10-99LN
cult = 0%	cult = 3%	cult = 21%	cult = 3%	cult = 17%
0/30	1/29	6/29	1/29	5/29

ELISA= 0%	ELISA= 31%	ELISA= 62%
0/30	9/29	18/29

Objective 1: 0 ELISA and culture positive at 1st sampling. 9 ELISA pos (Mod 25 to 50%) and 1 culture pos at 2nd sampling. 18 ELISA pos (High > 50%) and 6 culture pos (Low 0 to 25%) at 3rd and last pre-harvest sampling. All 7 culture pos from different animals. 11 hogs ELISA pos once; 8 hogs ELISA pos twice; and 19 different hogs ELISA pos once or twice. 2/7 culture pos hogs were ELISA pos twice; 3/7 culture pos hogs were ELISA pos once; **5/7 (71%) culture pos hogs pre-harvest were ELISA pos once or twice**; and **2/7 (29%) culture pos hogs pre-harvest were ELISA neg on all three samplings.. 13/19 hogs (68%) ELISA pos once or twice pre-harvest were culture negative pre-harvest on all three samplings. 2 Hogs ELISA neg on all samples was culture pos pre-harvest. 2/10 ELISA neg hogs (20%) on all samples were culture pos pre-harvest.**

Objective 2: 18 hogs (High 62%) were ELISA pos at last sampling, prior to slaughter while 5 hogs (Low 17%) post-harvest were lymph node pos. **ELISA pos antibody** immediately **pre-harvest was not individually or group correlated** with **lymph node culture post-harvest.**

Objective 3: 6 hogs (Low 21%) had pos pre-harvest fecal cultures at the last sampling prior to slaughter and one **different** hog (Low 3%) post-harvest had combined cecal/rectal pos culture. **5/6 feces culture pos hogs 5 days prior to slaughter were cecal/rectal feces culture neg at slaughter. Feces culture positives immediately prior to slaughter and at slaughter were not individually or group correlated (>15% diff in group comparison).**

ADG N = 1.62lbs PC = 1.34lbs PE = 1.71 lbs PCPE = 1.75lbs NSD (P = 0.36)

Farm "D, #3 Group"

5-19-99	6-29-99	8-3-99	8-11-99Feces	8-11-99 LN
cult = 3%	**cult = 4%**	**cult = 14%**	**cult = 32%**	**cult = 64%**
1/30	**1/28**	**4/28**	**9/28**	**18/28**
ELISA= 0%	**ELISA= 0%**	**ELISA= 46%**		
0/30	**0/28**	**13/28**		

Objective 1: 0 ELISA and one culture pos at 1st and 2nd sampling. 13 ELISA pos (Mod 46%) and 4 culture pos (Low 14%) at 3rd and last sampling pre-harvest. All 6 culture pos pre-harvest were from different animals. 13 hogs were ELISA pos once, all at the last pre-harvest sampling; no hogs were ELISA pos twice pre-harvest. **1/6 hogs culture pos pre-harvest was ELISA pos once. 5/6 hogs culture pos pre-harvest were ELISA neg at all pre-harvest samplings. 12/13 hogs (92%) ELISA pos once pre-harvest were culture negative on all samplings pre-harvest. 5/15 ELISA neg hogs (33%) on all samples were culture pos pre-harvest.**

Objective 2: 13 hogs were ELISA pos (Mod 46%) at the 3rd sampling, prior to slaughter while 18 hogs (High 64%) post-harvest were lymph node pos, **8 days later. ELISA pos antibody** immediately **pre-harvest was not individually or group correlated.**

Objective 3: 4 hogs (Mild 14%) had pre-harvest pos fecal cultures at 3rd sampling, prior to slaughter and **9 hogs (Mod 32%)** (**7 different** and 2 of the same hogs) **had post-harvest cecal/rectal pos cultures**. 6/9 hogs with cecal/rectal pos cultures also had pos lymph node cultures at slaughter. **Feces culture positives immediately pre- and post-harvest were not individually or group correlated**.

ADG N = 1.62lbs PC = 1.30lbs PE = 1.42lbs PCPE = NV* NSD (P = 0.16)

NV* = not valid because of sample size of one.

FARM "R, #1 Group"

7-21-98	8-25-98	9-24-98	11-24-98	12-7-98Feces	12-7-98LN
cult = 0%	cult = 13%	cult = 3%	cult = 0%	cult = 3%	cult = 0%
0/30	4/30	1/29	0/29	1/29	0/29
ELISA = 0%	ELISA = 37%	ELISA = 0%	ELISA = 10%		
0/30	11/30	0/29	3/29		

Objective 1: 0 ELISA and culture pos at 1st sampling. 11 ELISA pos (Mod) and 4 culture pos (Low) at 2nd sampling. 0 ELISA and 1 culture pos (Low) at 3rd sampling. 3 ELISA pos (Low) and 0 culture pos at 4th sampling. 5 total pos culture pre-harvest; 3 from different hogs and 2 from same hog (4 total hogs culture pos). 12 hogs were ELISA pos once; one hog was ELISA pos twice. 13 total ELISA pos hogs once or twice**. 3/4 (75%) hogs culture pos pre-harvest were never ELISA pos; 1/4 (25%) hog culture pos twice pre-harvest was ELISA pos once. 12/13 ELISA pos hogs once or twice (92%) pre-harvest were culture neg at all samplings pre-harvest. 3/17 hogs ELISA neg on all samplings (18%) were culture pos pre-harvest. 3 Salmonella derby (B serogroup), one S. newport (C2), and one not reported of pre-harvest isolates; one S. agona (B) isolated post-harvest.**

Objective 2: 3 hogs (Low 10%) were ELISA pos at 4th sampling, prior to slaughter while 0 hogs (Low) were lymph node pos post-harvest. There was no individual correlation but was a group correlation.

Objective 3: 0 hogs (Low 0%) had pre-harvest pos cultures at 4th sampling and 1 different hog (Low 3%) had pos post-harvest cecal/rectal combined fecal culture. There was no individual correlation but there was a group correlation pre- and post-harvest.

ADG N = 1.44lbs PC = 1.38 lbs PE = 1.38lbs PCPE = NV* NSD (P = 0.84)

NV* = not valid because of sample size of one.

Farm "R, #2 Group"

2-24-99	3-29-99	4-29-99	6-9-99	6-17-99Feces	6-17-99 LN
cult= 0%	cult= 0%	cult= 0%	cult= 0%	cult= 77%	cult= 28%
0/30	0/30	0/30	0/30	22/29	8/29

ELISA=0%	ELISA= 3%	ELISA= 17%	ELISA= 23%
0/30	1/30	5/30	7/30

Objective 1: 0 ELISA and culture pos at 1st sampling. 1 ELISA pos (Low 3%) and 0 culture pos at 32nd sampling. 5 ELISA pos (Low 17%) and 0 culture pos at 3rd sampling. 7 ELISA pos (Low 23%) and 0 culture pos at 4th sampling, prior to slaughter. 0 culture pos in all samples pre-harvest. 7 hogs ELISA pos once and 3 hogs pos twice pre-harvest; 9 hog ELISA pos once or twice in all samples pre-harvest. **10/10 (100%) of hogs ELISA pos once or twice pre-harvest were culture neg at all samplings pre-harvest. 0/20 ELISA neg hogs (0%) at any sampling pre-harvest were culture pos. 7 Salmonella agona (B), 6 S. derby (B serogroup), 2 S. anatum (E1), 2 S. bredeney (B), 3 multiple serotypes, one untypable , and one S. saint-paul (B) isolated at slaughter from cecal/rectal feces. 2 Salmonella derby (B), one S. agona (B), one S. typhimurium (B), one S. saint-paul (B), one S. havana (B), and 2 not reported were isolated from lymph nodes at slaughter. Feces and lymph nodes isolates were never the same serotype in any individual hog at slaughter.**

Objective 2: 7 hogs (Low 23%) were ELISA pos at 4th sampling, prior to slaughter while 8 hogs (3 of the same and 5 different hogs) were lymph node pos (Mod 28%) post-harvest (<15% diff criteria). **There was no individual correlation. Since the number pos by ELISA and lymph node culture pre- and post-harvest was nearly identical, there was a group correlation.**

Objective 3: 0 hogs had pos pre-harvest cultures at 4th sampling, prior to slaughter and 22 (77%) had pos cecal/rectal cultures **8 days later** at slaughter. **There was no individual or group correlation between these cultures pre- and post-harvest.**

ADG N = 1.39lbs PC = None PE = 1.49lbs PCPE = None NSD (P = 0.22)
Farm "R, #3 Group"

5-25-99	7-8-99	7-29-99	8-26-99	9-8-99 Feces	9-8-99 LN
cult= 0%	cult= 0%	cult= 0%	cult= 0%	cult= 17%	cult= 10%
0/29	0/29	0/29	0/29	5/29	3/29
ELISA= 3%	ELISA= 21%	ELISA= 24%	ELISA= 10%		
1/30	6/29	7/29	3/29		

Objective 1: 1 ELISA pos (Low 3%) and 0 culture pos (Low) at 1st sampling. 6 ELISA pos (Low 21%) and 0 culture pos at 2nd sampling. 7 ELISA pos (Low 24%) and 0 culture pos at 3rd sampling. 3 ELISA pos (Low 10%) and 0 culture pos (Low) at 4th sampling. 0 hogs were culture pos at all samplings pre-harvest. A total of 9 hogs ELISA pos in all samples pre-harvest; 4, 2, and 3 hogs ELISA pos once, twice, and three times, respectively. **9/9 (100%) ELISA pos one or more times were all culture neg pre-harvest. 0/20 ELISA neg hogs (0%) at all sample pre-harvest was culture pos.**

Objective 2: 3 hogs (Low 10%) were ELISA pos at 4th sampling, prior to slaughter while 3 hogs (Low 10%) were lymph node pos at slaughter, **13 days later**. **None of the same hogs were ELISA and lymph node pos so there was no individual correlation. The same Low number of hogs were ELISA and lymph node pos so there was a group correlation.**

Objective 3: 0 hogs (Low) had pos cultures at the 4th sampling, prior to slaughter and 5 (Low 17%) had pos cecal/rectal cultures at slaughter(> 15% diff). **There was no individual or group correlation pre- and post-harvest.**

ADG N = 1.04lbs PC = None PE = 1.02lbs PCPE = None NSD (P = 0.81)

Farm "J, #1 Group"

8-5-98	9-3-98	10-8-98	11-12-98	11-17-98Feces	11-17-98LN
cult = 0%	cult = 13%	cult = 37%	cult = 50%	cult = 79%	cult = 59%
0/30	4/30	11/30	15/30	23/29	17/29

ELISA = 0%	ELISA = 53%	ELISA = 27%	ELISA = 70%
0/30	16/30	8/30	21/30

Objective 1: 0 ELISA and culture pos at 1st sampling. 16 ELISA pos (High 53%) and 4 culture pos (Low 13%) at 2nd sampling. 8 ELISA pos (Mod 27%) and 11 culture pos (Mod 37%) at 3rd sampling. 21 ELISA pos (High 70%) and 15 culture pos (High 50%) at 4th sampling. 15 hogs were culture pos once pre-harvest; 6 hogs were culture pos twice pre-harvest; one hog was culture pos three times pre-harvest; 22 hogs were culture pos one to three times pre-harvest. 12 hogs ELISA pos once; 12 hogs ELISA pos twice; 3 hogs ELISA pos three times; 27 hogs ELISA pos one to three times. **20 hogs culture pos pre-harvest were ELISA pos one to three times. 6/27 ELISA pos (22%) 1 to 3 times were culture neg at all samples pre-harvest. 2/3 ELISA neg hogs (67%) at any sample pre-harvest were culture pos. 19/27 ELISA pos hogs (70%) at any sample pre-harvest were culture pos pre-harvest. 19 Salmonella derby (B), 3 S. anatum (E1), 6 not reported yet, and 1 S. typhimurium copenhagen (B) for serotyping pre-harvest. 22 S. derby (B), 7 S. anatum (E1), 1 S. contaminated culture, and 9 not reported yet post-harvest.**

Objective 2: 21 hogs ELISA pos (High 70%) at the 4th sampling prior to slaughter while 17 were lymph node culture pos (High 59%) at slaughter, **5 days later**. 13 of these same 21 ELISA pos hogs were lymph node pos post-harvest. **ELISA pos antibody at 4th sampling pre-harvest was individually and group correlated with pos lymph node culture post-harvest.**

Objective 3: 15 hogs (High 50%) had pre-harvest pos cultures at 4th sampling while 23 hogs (79%) had pos cecal/rectal cultures (> 15% diff); 14/15 hogs with pre-harvest pos culture had post-harvest cecal/rectal combined pos cultures. **Pre-harvest pos culture at 4th sampling was individually correlated but was not group correlated to post-harvest pos cecal/rectal combined cultures.**

ADG N = NV* PC = NV* PE = 1.26lbs PCPE = 1.31 lbs NSD (P = 0.390)

NV* = not valid because of sample size of one (N) and two (PC).

Farm "J, #2 Group"

2-17-99	3-26-99	4-29-99	5-17-99Feces	5-17-99 LN
cult= 0%	cult= 27%	cult= 10%	cult= 22%	cult= 15%
0/30	8/30	3/29	6/27	4/27
ELISA= 0%	ELISA= 33%	ELISA= 70%		
0/30	10/30	20/29		

Objective 1: 0 ELISA and culture pos at 1st sampling. 10 ELISA pos (Mod 33%) and 8 culture pos (Mod 27%) at 2nd sampling. 20 ELISA pos (High 70%) and 3 culture pos (Low 10%) at 3rd and last sampling, **18 days prior to slaughter**. 7 and 2 hogs were culture pos once and twice, respectively, pre-harvest; 9 hogs were culture pos once or twice pre-harvest. 16 and 7 hogs were ELISA pos once and twice, respectively, pre-harvest; 23 hogs were ELISA pos once or twice pre-harvest. **6/9 (67%) hogs culture pos once or twice pre-harvest were ELISA pos. 17/23 ELISA pos hogs (74%) once or twice pre-harvest were culture neg at all samples pre-harvest. 3/7 ELISA neg hogs (43%) at any sample was culture pos pre-harvest. 6/9 ELISA pos (67%) at ant sample was culture pos pre-harvest.**

Objective 2: 20 hogs ELISA pos (High 70%) at last sampling prior to slaughter while 4 hogs (Low 15%) (3 different and 1 the same) were lymph node culture pos post-harvest. **There was no individual or group correlation between these pre- and post-harvest tests.**

Objective 3: 3 hogs (Low 10%) had pre-harvest pos cultures at 3rd sampling prior to slaughter while 6 hogs (Low 22%) had pos cultures post-harvest (only 1 hog was culture pos pre-and post-harvest). **There was no individual correlation but there was a group correlation pre- and post-harvest.**

ADG N = 1.47lbs PC = 1.52lbs PE = 1.50lbs PCPE = 1.48lbs NSD (P = 0.94)

Farm "J, #3 Group"

5-12-99	6-24-99	7-28-99	8-11-99Feces	8-11-99 LN
cult= 0%	cult= 10%	cult= 0%	cult= 64%	cult= 10%
0/30	3/30	0/29	18/28	3/29
ELISA= 0%	ELISA= 67%	ELISA=38%		
0/30	20/30	11/29		

Objective 1: 0 ELISA and culture pos at 1st sampling. 20 ELISA pos (High 67%) and 3 culture pos (Low 10%) at 2nd sampling. 11 ELISA pos (Mod 38%) and 0 culture pos at 3rd and last sampling, **14 days prior to slaughter. 3 hogs were culture pos once pre-harvest. 13 hogs ELISA pos once, 9 hogs ELISA pos twice; 22 hogs ELISA once or twice pre-harvest. 3/3 (100%) hogs culture pos were also ELISA pos at least once (one culture pos was ELISA pos twice). 19/22 ELISA pos (86%) once or twice were never culture pos pre-harvest. 0/7 ELISA neg (0%) at any sample was culture pos pre-harvest. 3/22 ELISA pos (14%) any sample were culture pos pre-harvest.**

Objective 2: 11 hogs ELISA pos (Mod 38%) at 3rd sampling prior to slaughter while 3 hogs were lymph node pos (Low 10%) at slaughter; there was no individual or group correlation.

Objective 3: 0 hogs (Low) had pre-harvest pos cultures while 18 hogs (High 64%) had pos cultures at slaughter, **14 days later**. **There was no individual or group correlation pre- and post-harvest.**

No ADG data on this group.

Farm "E, #1 Group"

8-12-98	9-10-98	10-13-98	11-30-98	12-7-98Feces	12-7-98LN
cult = 0%	cult = 0%	cult = 7%	cult = 7%	cult = 7%	cult = 21%
0/30	0/29	2/30	2/30	2/29	6/29
ELISA = 13%	ELISA = 27%	ELISA = 27%	ELISA = 37%		
4/30	8/30	8/30	11/30		

Objective 1: 4 ELISA pos (Low 13%) and 0 culture pos at 1st sampling. 8 ELISA pos (Mod 27%) and 0 culture pos at 2nd sampling. 8 ELISA pos (Mod 27%) and 2 culture pos (Low 7%) at 3rd sampling. 11 ELISA pos (Mod 37%) and 2 culture pos (Low 7%) at 4th sampling. **4 different hogs cultured pos pre-harvest. 7 hogs were ELISA pos once; 7 hogs were ELISA pos twice; 2 hogs were ELISA pos three times; 1 hog was ELISA pos four times; and 17 total hogs were ELISA pos one to four times. 4/4 (100%) of hogs culture pos once pre-harvest were ELISA pos once or twice. 13/16 hogs (81%) ELISA pos one to three times were never culture pos at any sampling pre-harvest. 0/13 ELISA neg (0%) at any sample was culture pos. 3/16 ELISA pos (19%) at any sample were culture pos pre-harvest. 2 Salmonella cerro (K serogroup), 1 S. braenderup (C1) and 1 S. minnesota (L) isolated pre-harvest. Eight S. braenderup (C1) isolated at slaughter. The 1 hog with S. braenderup in feces on last live sampling had the same serotype isolated from cecal/rectal contents and lymph nodes. Another hog at slaughter had S. braenderup isolated from cecal/rectal and lymph nodes, but no isolates or pos ELISA pre-harvest.**

Objective 2: 11 hogs were ELISA pos (Mod 37%) at 4th sampling while 6 hogs (Low 21%) were lymph node pos (only 1 hog both ELISA/lymph node pos) at slaughter, 7 days later (> 15% diff). There was no individual or group correlation between.

Objective 3: 2 hogs (Low 7%) had pre-harvest pos cultures at 4th sampling while 2 hogs (Low 7%) had post-harvest cecal/rectal combined pos culture**. 1 of 2 hogs had pre- and post-harvest pos culture; there was no individual correlation. There was a group correlation.**

ADG N = 1.43lbs PC = None PE = 1.30lbs PCPE = 1.51 lbs NSD (P = 0.20)

Farm "E, #2 Group"

3-23-99	4-22-99	5-6-99	7-15-99	7-19-99Feces	7-19-99 LN
cult= 10%	cult= 13%	cult= 50%	cult= 28%	cult= 67%	cult= 37%
3/30	4/30	15/30	8/29	18/27	10/27
ELISA= 0%	ELISA= 0%	ELISA= 10%	ELISA= 3%		
0/30	0/30	3/30	1/29		

Objective 1: 0 ELISA and culture pos on 1st sampling. 0 ELISA and 4 culture pos (Low) on 2nd sampling. 3 ELISA pos (Low) and 15 culture pos (High 50%) on 3rd sampling. 1 ELISA pos (Low) and 8 culture pos (Mod 28%) on 4th sampling. 15, 3 and 3 hogs were culture pos once, twice and three times, respectively, pre-harvest; 21 hogs culture pos one to three times pre-harvest. 4 hogs were ELISA pos once. **1/4 ELISA pos (25%) at any sample was culture neg pre-harvest. 16/23 ELISA neg (70%) at all samples were culture pos pre-harvest. 3/4 ELISA pos (75%) at any time were culture pos pre-harvest.**

Objective 2: 1 hog ELISA pos (Low 3%)at the 4th sampling prior to slaughter while 10 hogs lymph node pos (Mod 37%) at slaughter, **4 days later**. **There was no individual or group correlation.**

Objective 3: 8 hogs had pos cultures (Mod 28%) immediately prior to slaughter while 18 had pos cultures (High 67%) at slaughter. **There was no individual or group correlation.**

ADG N = 1.17lbs PC = 1.13lbs PE = None PCPE = NV* NSD (P = 0.50)

NV* = not valid because of sample size of three.

Farm "E, #3 Group"

9-6-99 9-8-99Feces 9-8-99 LN

cult= 23% cult= 80% cult= 20%

7/30 24/30 6/30

ELISA= 73%

22/30

Objective 1: Only one pre-slaughter sampling done. 22 ELISA pos (High 73%) and 7 culture pos (Low 23%).

Objective 2: 22 hogs ELISA pos (High 73%) pre-slaughter while 6 lymph node pos (Low 20%) at slaughter, **2 days later. There is no individual or group correlation.**

Objective 3: 7 hogs (Low 23%) had pre-harvest pos cultures while 24 hogs (80%) had pos cecal/rectal cultures at slaughter. **There is no individual or group correlation.**

No ADG data on this group.

Farm "C, #1 Group"

7-29-98	10-1-98	11-18-98	12-1-98	12-30-98Feces	12-30-98LN
cult = 0%	cult = 0%	cult = 3%	cult = 0%	cult = 79%	cult = 43%
0/30	0/30	1/29	0/29	22/28	12/28
ELISA = 0%	ELISA = 0%	ELISA = 8%	ELISA = 31%		
0/30	0/30	2/25	9/29		

Objective 1: 0 ELISA and culture pos at 1st and 2nd sampling. 2 ELISA pos (Low 8%) and 1 culture pos (Low 3%) at 3rd sampling. 9 ELISA pos (Mod 31%) and 0 culture pos at 4th sampling. **Only one culture pos pre-harvest. 7 hogs ELISA pos once; 2 hogs ELISA pos twice; 9 different hogs ELISA pos once or twice. One culture pos hog never ELISA pos. 9/9 ELISA pos once or twice pre-harvest (100%) were culture neg on all samples pre-harvest. 1/20 ELISA neg (5%) at all samples was culture pos pre-harvest. 0/9 ELISA pos (0%)on any sample was culture pos pre-harvest. 1 Salmonella serotype not reported pre-harvest; 15 S. derby (B), 9 S. cerro (K), 2 S. infantis (C1) and 1 probable S. infantis (C1), 1 S. anatum (E1), 1 untypable 3,10:LW monophasic, and 5 not reported yet post-harvest.**

Objective 2: 9 hogs (Mod 31%) were ELISA pos at the 4th sampling prior to slaughter while 12 hogs (Mod 43%)lymph node pos at slaughter, **17 days later. ELISA pos antibody at 4th**

sampling pre-harvest was not individually correlated but was group correlated with pos lymph node culture post-harvest.

Objective 3: 0 hogs (Low) had pre-harvest pos cultures at 4th sampling and 22 (High 79%) had pos post-harvest cecal/rectal combined fecal cultures. **There was no individual or group correlation between pos cultures at 4th sampling pre-harvest and pos post-harvest cultures (there was an inverse relationship).**

ADG N = 1.62lbs PC = NV* PE = 1.60lbs PCPE = None NSD (P = 0.85)

NV* = not valid because of sample size of one.

Farm "C, #2 Group"

2-23-99	4-21-99	5-20-99	7-14-99	7-19-99Feces	7-19-99 LN
cult= 0%	cult= 0%	cult= 0%	cult= 0%	cult= 25%	cult= 0%
0/30	0/30	0/30	0/30	7/28	0/28
ELISA= 0%	ELISA= 43%	ELISA= 13%	ELISA= 0%		
0/30	13/30	4/30	0/30		

Objective 1: 0 ELISA and culture pos at 1st sampling. 13 ELISA pos (Mod 43%) and 0 culture pos at 2nd sampling. 4 ELISA pos (Low 13%) and 0 culture pos at 3rd sampling. 0 ELISA and 0 culture pos at 4th sampling, **5 days prior to slaughter**. **0 hogs culture pos pre-harvest. 9 and 4 hogs ELISA pos once and twice, respectively, pre-harvest; 13 hogs ELISA pos once or twice. 13/13 hogs ELISA pos once or twice (100%) were culture neg at all times pre-harvest. 4/16 ELISA neg (25%) at all samples were culture pos pre-harvest. 0/13 ELISA pos (0%) at any sample was culture pos pre-harvest. 2 Salmonella agona (B), 2 S. derby (B), 1 S. typhimurium (B), 1 S. livingstone (C1) and 1 untypeable isolated from cecal/rectal contents of 7 different hogs at slaughter.**

Objective 2: 0 hogs were ELISA pos at 4th sampling prior to slaughter while 0 hogs were lymph node pos at slaughter. **There was an individual and group correlation.**

Objective 3: 0 hogs had pre-harvest pos cultures (Low) while 7 hogs had pos cultures (Mod 25%) at slaughter, **5 days later. There was no individual or group correlation.**

ADG N = 1.49lbs PC = None PE = 1.43lbs PCPE = None NSD (P = 0.44)

Farm "C, #3 Group"

6-23-99	9-14-99	10-25-99	11-2-99 Feces	11-2-99 LN
cult= 7%	cult= 0%	cult= 0%	cult= 14%	cult= 14%
2/30	0/29	0/29	4/29	4/29
ELISA= 0%	ELISA= 38%	ELISA= 0%		
0/30	11/29	0/29		

Objective 1: 0 ELISA and 2 culture pos (Low 7%) at 1st sampling. 11 ELISA pos (Mod 38%) and 0 culture pos (Low) on 2nd sampling. 0 ELISA pos (Low) and culture pos (Low) on 3rd sampling. **Only 2 hogs culture pos pre-harvest. 11 different hogs were ELISA pos once. 11/11 hogs ELISA pos (100%) at any sample were never culture pos pre-harvest. 2/18 ELISA neg (11%) at all samples were culture pos pre-harvest. 0/11 ELISA pos (0%) at any sample was culture pos pre-harvest.**

Objective 2: 0 hogs (Low 0%) were ELISA pos at 3rd sampling pre-harvest while 4 hogs were lymph node pos (Low 14%) at slaughter, **8 days later. There was no individual correlation. There was a group correlation.**

Objective 3: 0 hogs (Low 0%) had pre-harvest pos cultures while 4 hogs (Low 14%) had pos cecal/rectal cultures at slaughter. **There was no individual correlation. There was a group correlation.**

ADG N = 1.35 lbs PC = NV* PE = 1.60lbs PCPE = None Sig Diff (P = 0.03)**

NV* = not valid because of sample size of two.
****** = No significant difference with Duncan's Test (MSE = 0.05)**

VI A. RESULTS SUMMARY:

Objective 1:

ELISA and culture results in individually identified hogs and within the same group of hogs was similar or varied greatly when sampled monthly during the grower- finisher phase of production. 14/15 groups (Group #3E not initially sampled) started as relatively "Salmonella clean" and became ELISA and/or culture positive at variable rates or remained relatively "clean"as they grew to market weight. 181/234 = 77% ELISA pos 1 to 4 times were culture neg at all samples pre-harvest. 39/205 = 19% ELISA neg on all samples were culture pos on 1 to 3 samples pre-harvest. 3 S. derby (B serogroup) and 2 S. typhimurium copenhagen (B sergroup) are the 5 serotypes reported to date for these 19% ELISA FALSE NEGATIVES pre-harvest. 19 S. derby (B serogroup), 1 S. typhimurium copenhagen (B serogroup), 3 S. anatum (E1 serogroup), 3 S. newport (C2 serogroup), 1 S. braenderup (C1 serogroup), 1 S. cerro (K serogroup), and 1 S. minnesota (L serogroup) are the 29 serotypes reported to date for the ELISA pos/culture pos swine pre-harvest. Serotypes of many S. isolates sent to NVSL not reported yet.

110 Salmonella isolates were cultured from 88 pos hogs pre-harvest and 262 S. isolates were cultured from 201 pos hogs at slaughter (2.3X and 2.4 X more pos hogs and isolates, respectively, at slaughter versus all samples pre-slaughter).

ADG data was available on 13/15 groups. There was NO WITHIN GROUP SIGNIFICANT DIFFERENCE in ADG between N, PC, PE, PCPE animals in 12/13 group data sets. The exception, Group #3 C, had SIGNIFICANT HIGHER ADG in PE animals (P = 0.03), however there was NSD using Duncan's Test (MSE = 0.05). When all ADG data was pooled and analyzed, there was NSD (P = 0.64) between groups; N = 1.38lbs, PC = 1.34lbs, PE = 1.40lbs, PCPE = 1.41 lbs. There was NO STATISTICALLY SIGNIFICANT REDUCTION in ADG by pos culture alone (PC), pos culture/pos ELISA (PCPE), or pos ELISA alone (PE).

STATISTICAL ANALYSIS OF ALL INDIVIDUAL AND GROUP DATA SHOWED: A to B (P = 0.15); C to D (P = 0.44); E to B (P = 0.07); F to D (P = 0.04); A to C (P = 0.56); A to D (P = 0.17); B to C (P = 0.21); B to D (P = < 0.0001); E to F (P = 0.96); B to F (P = 0.91); and E to D (P = 0.17).

Objective 2:

In "D, R, J, E, C" farm groups, based on the non-statistical criteria previously outlined, there is NO INDIVIDUAL ANIMAL CORRELATION between ELISA pos at the last sampling pre-harvest and the post-harvest lymph node culture in 13/15 (87%) of groups, and NO GROUP CORRELATION between these pre- and post-harvest tests in 8/15 (53%) groups. Statistical analysis of all individual animal and group data showed that the value of the immediate pre-slaughter ELISA test to predict pos lymph node culture at slaughter was NOT SIGNIFICANT (P = 0. 44, comparison C to D). However, the value of 1 or more pos ELISA on multiple tests pre-harvest to predict pos lymph node culture at slaughter TRENDED TO BE SIGNIFICANT (P = 0.04, comparison F to D).

Objective 3:

In "D, R, J, E, C" farm groups, based on non-statistical criteria previously outlined, there is NO INDIVIDUAL CORRELATION between feces culture pos at the last sampling immediately pre-harvest and the post-harvest cecal/rectal combined culture pos in 14/15 (93%) of groups and NO GROUP CORRELATION between these pre- and post-harvest cultures on 10/15 (67%) of groups. Statistical analysis of all individual animal and group data showed that the value of the immediate pre-slaughter pos fecal culture to predict pos cecal/rectal combined culture at slaughter was NOT SIGNIFICANT (P = 0.15, comparison

A to B). The value of pos fecal sample at any sample pre-harvest to predict pos cecal/rectal combined culture at slaughter was improved but NOT SIGNIFICANT (P = 0.07, comparison E to B).

Statistical analysis of all individual and group data showed the value of slaughter pos cecal/rectal cultures to predict pos lymph node cultures at slaughter was HIGHLY SIGNIFICANT (P < 0.0001, comparison B to D).

VI B. CONCLUSIONS:

Data on these 15 groups demonstrates that there is NO SIGNIFICANT STATISTICAL or NON-STATISTICAL CORRELATION between immediate pre-slaughter ELISA compared to slaughter lymph node culture, and pre-slaughter fecal culture compared to cecal /rectal fecal culture (tests 2 to 18 days apart [9 day average]). There was a TREND TO SIGNIFICANCE when any pos on multiple ELISA were used pre-harvest to predict pos lymph node culture at slaughter, and IMPROVED BUT NOT SIGNIFICANT value of any pos of multiple pre-harvest fecal cultures to predict pos on cecal/rectal cultures at slaughter. However, multiple tests pre-harvest are not practical to predict the Salmonella status of groups of hogs before they go to slaughter. There was a HIGHLY SIGNIFICANT CORRELATION between pos cecal/rectal cultures and pos lymph node culture at slaughter. Also, 2.4 X more total number of Salmonella isolates were cultured from cecal/rectal combined cultures and lymph nodes at slaughter (262) than feces culture pre-harvest (110), even though the culture pos opportunity was greater pre-harvest than at slaughter because of 3 or 4 fecal samples per animal. THE LACK OF CORRELATION BETWEEN IMMEDIATE PRE- AND POST-HARVEST TESTS, THE HIGHLY SIGNIFICANT CORRELATION BETWEEN CECAL/RECTAL AND LYMPH NODE POS CULTURE AT SLAUGHTER, AND THE 2.4X HIGHER NUMBER OF S. ISOLATES AT SLAUGHTER VS. ALL SAMPLES PRE-HARVEST DEMONSTRATE

EVIDENCE FOR SALMONELLA CONTAMINATION AT THE SLAUGHTER FACILITY AND/OR IN TRANSIT, AFTER HOGS EXIT THE FARM.

Individual farm data such as Group #3, D (8 days between samples, no extended lairage, labor problems at packing plant, sporadic daily kills); Group #2, R (8 days between samples, no extended lairage, labor problems at packing plant, sporadic daily kills); Group #3, J (14 days between samples, no extended lairage, labor problems at packing plant, sporadic daily kills); Group #2, E (4 days between samples, no extended lairage, labor problems at packing plant, sporadic daily kills); Group #1, C (17 days between samples, 1 day extended lairage); and Group #2, C (5 days between sampling, no extended lairage, labor problems at packer, sporadic daily kills) SHOW THAT HOGS TESTING VERY CLEAN IMMEDIATELY PRIOR TO SLAUGHTER TESTED HIGHLY CONTAMINATED AT SLAUGHTER. Days between samples may contribute some contamination (eg. 14, 17 days) but other groups with extended days between samples had consistent results pre- and post-slaughter (eg. Group #2, J; Group#1, R; 18, 13 days, respectively); most of previously mentioned problem groups had a short time-span between samples (eg. 8, 8, 4, 5 days). Confounding this evidence is Group #3 C, which had 8 days between sampling, a 1 day extended lairage (2 days at packer), labor problems at packer, and sporadic daily kills but had very similar pre- and post-harvest test results. Feeding, shipping, and holding procedures for all groups prior to slaughter was similar. Procedures for pen sanitation at slaughter may have been improved when Group #3, C was marketed. Salmonella contamination of groups of hogs testing clean on the farm immediately prior to slaughter cannot always be predicted by extended lairage and other variables mentioned. Note also that the group relationship of fecal culture immediately pre-slaughter to cecal/rectal fecal culture at slaughter and the immediate pre-slaughter ELISA to slaughter lymph node culture was pos correlated by non-statistical methodology (15% or less variation) in 5/15 (33%) and 7/15 (47%) of groups, respectively, even though there was no statistical correlation. Therefore, transportation and lairage stress as a cause of Salmonella shedding and contamination of live hogs after exiting the farm did not seem to be important in these groups, which were in the minority. Salmonella contamination of groups of hogs testing clean on the farm immediately prior to slaughter cannot always be predicted by transport and lairage stress causing Salmonella shedding in hogs after exiting the farm. NEVERTHELESS, THESE DATA SHOW THERE WAS A DISTURBING DIFFERENCE BETWEEN THE SALMONELLA PRE-SLAUGHTER STATUS OF HOGS ON THE FARM AND THEIR STATUS AT THE PACKER AFTER SLAUGHTER.

THESE DATA DEMONSTRATE THAT ON THE FARM, PRE-HARVEST ASSESSMENT OF THE SALMONELLA STATUS OF GROUPS OF HOGS 2 TO 18 DAYS PRIOR TO SLAUGHTER MINIMIZES THE CONFOUNDING VARIABLES INTRODUCED WHEN PREDICTION OF THE IMMEDIATE PRE-HARVEST SALMONELLA STATUS WAS ATTEMPTED AT SLAUGHTER.

The value of pre-slaughter pos feces culture to predict ELISA pos sampled on the same day was NON SIGNIFICANT (P = 0.56, comparison A to C). 39/205 = 19% ELISA neg on all samples pre-harvest were culture pos at least once pre-harvest; THESE ARE FALSE NEG RESULTS and common serogroup B serotypes (derby and typhimurium copenhagen) were represented in these false neg tests. 181/234 = 77% ELISA pos on 1 to 4 samples pre-harvest were always culture neg pre-harvest (44, 6, 1 ELISA neg 2X, 3X, 4X, respectively; 51/181 = 28% ELISA pos 2-4X, culture neg pre-harvest). Assuming these results are all FALSE POS is probably incorrect since it is expected that many Salmonella infected or transiently infected hogs will intermittently shed organisms into feces and thus fecal cultures are "hit and miss" and may be neg. However, out of such a high percentage of pos ELISA/neg culture on individually identified animals (51/181 were multiple pos ELISA tests [28%]), many may be FALSE POS results or just do not supply the reliable information for a veterinarian to classify a group of hogs as to Salmonella status immediately prior to slaughter.

There was a TREND TO SIGNIFICANCE (P = 0.04, comparison F to D) for any pos on multiple ELISA tests pre-harvest to predict pos lymph node culture at slaughter, but this compares a pre- to post-harvest relationship and multiple ELISA tests (as well as multiple culture or PCR) are not practical as pre-harvest food safety tools. Note again that 181/234 = 77% ELISA pos on 1 to 4 samples (28% ELISA pos on 2 to 4 samples) were always culture neg, and 39/205 = 19% ELISA neg on all samples pre-harvest culture pos at least once pre-harvest (FALSE NEG). ELISA pos may indicate a previous exposure to Salmonella, but the high percentage of ELISA pos/culture neg swine in this study even bring that hypothesis into question; also, lack of significant decrease in ADG for any PC, PE, or PCPE pre-harvest apparently shows how mild non-host adapted Salmonella infection is in finisher hogs, which may result in minimal immune system activation and transient or no antibody response (infection or transient infection late in finisher stage may also contribute to lack of weight gain depression). The supposition of minimal stimulation of immune response after oral exposure to non-host adapted Salmonella is supported by 19

% FALSE NEG ELISA RESULTS. Therefore, ELISA would have to be combined with culture to have value as a pre-harvest food safety tool. Considering the $6 per test cost of ELISA and sampling costs whether collected pre-slaughter or at slaughter, THE QUESTION IS: Does ELISA provide enough information to justify its use with culture? THESE DATA SEEM TO INDICATE THAT ELISA DOES NOT PROVIDE ENOUGH INFORMATION ABOUT THE SALMONELLA STATUS OF HOGS ON THE FARM ,PRE-SLAUGHTER, TO BE USED IN A PRE-HARVEST CERTIFICATION PROGRAM.

Considering that ELISA is designed to measure persistent antibody after Salmonella infection, and immediate pre-slaughter ELISA samples were obtained 2 to 18 days (9 day average) prior to slaughter, the results of ELISA from sera or meat juice collected at slaughter and substituted for ELISA results from sera collected immediately pre-slaughter (as in this study) may be similar when compared to pre-harvest fecal culture. IN OTHER WORDS, ELISA RESULTS FROM SAMPLES AT SLAUGHTER MAY HAVE NO SIGNIFICANT CORRELATION TO FECAL CULTURE PRE-HARVEST. IF THIS IS TRUE, ELISA RESULTS FROM SLAUGHTER SAMPLES MAY BE UNRELIABLE FOR CLASSIFYING THE IMMEDIATE PRE-HARVEST STATUS OF GROUPS OF FINISHER HOGS.

ANY TEST(S) USED TO CLASSIFY THE SALMONELLA STATUS OF GROUPS OF FINISHER SWINE SHOULD PROVIDE CONSISTENT RESULTS. Consistency or pos correlation is defined non-statistically in this study as 15% or less variation in pos rates between farm groups. Fecal cultures immediately pre-slaughter consistently classified these 15 farm groups R (1,2,3); J (1,2,3); E (1,2,3); C (1,23); D (1,2,3) as: Fecal culture 13/15 = 87% (3/3; 2/3; 2/3; 3/3; 3/3). ELISA was less consistent; 9/15 = 60% (3/3; 2/3; 0/3; 2/3; 2/3). This comparison does not take complete accuracy into consideration since there is no other reference test to compare ELISA and culture to in this study. However, a pos culture confirmed by serogrouping and serotyping is known to be positive and a pos ELISA is unconfirmed.

A previously unpublished study by the author classified (by same non-statistical definition) 22 pre-slaughter groups of 30 hogs on these same farms R (1,2,3,4,5); J (1,2,3,4,5); E (1,2,3,4,5,6); C (1,2,3,4); D (1,2) as: Fecal culture 18/ 22 = 82% (4/5; 4/5; 6/6; 4/4; 0/2); PCR 18/21 = 86% (4/4; 4/5; 6/6; 4/4; 0/2); and ELISA 10/20 = 50% (2/4; 3/5; 3/6; 2/3; 0/2). PCR confirms consistent culture results. ELISA is 50% consistent and had no comparison test for validation of consistent results. These data demonstrate FECAL CULTURE PRE-

HARVEST GAVE THE MOST CONSISTENT ASSESSMENT OF SALMONELLA STATUS OF GROUPS OF FINISHER HOGS ON THE FARM, IMMEDIATELY PRIOR TO SLAUGHTER.

FROM DATA IN THIS STUDY IT SEEMS THAT A CLASSIFICATION SYSTEM FOR SALMONELLA STATUS OF GROUPS OF FINISHER HOGS AND EVEN FARMS THEY ORIGINATE FROM COULD BE BASED ON FECAL CULTURE WITHIN ONE OR TWO WEEKS PRIOR TO SLAUGHTER. THE COST FOR CULTURE OF 30 HOGS, NOT COUNTING PROFESSIONAL FEE OR LABOR, MILEAGE, COLLECTION CONTAINERS, SAMPLE SHIPPING, AND RESULTS REPORTING WOULD BE A MINIMUM OF $150 to $200.

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