

**Title:** Pork harvest plant survey to determine possible points of variety meat contamination-  
**NPB #14-236**

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### **Industry Summary:**

The objective of optimizing value throughout the pork chain is enhanced by improving the value of export products that have little value to domestic consumers. Pork offal products, specifically variety meats, are products of normal consumption for many cultures around the world. With pork being the number one global protein source, a large percentage of that volume comes in the form of products that are non-traditional to American consumers. Further enhancement of pork value can be achieved if these items should be capitalized on in the export market with improved food safety and enhanced shelf-life. The export of meat products today are currently achieved through temperature control by shipment of frozen variety meats to international destinations. However, the initial contamination and microbial load plays a tremendous role in product shelflife and safety. The current project addresses the research needs to identify specific methods of organ meat contamination and possible best management practices to avoid such. Specifically, this project attempted to determine the opportunities during the harvest chain for potential product contamination and determine enhanced practices that might minimize that possible contamination.

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## **Scientific Abstract:**

Five pork harvest facilities located throughout the Southeast and Midwest were surveyed for potential microbial contamination of offal variety meat products. In addition, best management practices were observed to minimize product contamination during the harvest process. At each plant data were collected to include the heart, liver, kidney and lungs. Immediately after venting of the gut, swabs were taken of the four organs prior to removal from the carcass. In addition, tissue samples were excised immediately post USDA inspection for analysis of E. coli, Salmonella, and Campylobacter. When possible, scalding fluid temperature and pH was recorded and a sample collected for analysis. Offal trays were also swabbed in two plants. Data indicate the swabs taken immediately after venting of all the organs had less positives than organs placed on offal pans (5 vs 14). Further, the only Campylobacter positives were from plants that skinned vs scald plants (14 vs 0). In addition, the majority of environmental samples tested negative for Salmonella indicating adequate sanitation in the facilities.

## **Introduction:**

The opportunity to add value to export products not normally consumed in the US offers a unique opportunity to the US pork industry. Pork variety meats, a rich and economical source of essential nutrients, are prone to rapid microbial spoilage as well as a high incidence of pathogenic microorganisms. Salmonella is one of the significant foodborne pathogens present in raw poultry and meat products which is responsible for large number of life threatening foodborne diseases. Although the meat industry employs several food safety practices, only a few of them have been adapted for use in by-products due to the product's quality decline, possible health risks, lack of consumer demand and cost implications. Thus, issues still exist for variety export meats due to concerns about the health problems caused by foodborne pathogens and the demand to prolong the shelf life. However, the ability exists to enhance the food safety of products using natural antimicrobials and/or other antimicrobials or preservatives.

The use of such products in organ meats is a natural progression for products deemed acceptable for export markets, either fresh or processed. These compounds along with other commonly used processing aids have enhanced the safety and shelf life of meat products and are now prime targets for usage in the production of pork variety meats destined for export.

## **Objectives:**

The objective of this proposed project is to survey and evaluate pork harvest procedures and technologies to ascertain best management practices to minimize the possible contamination of pork variety meats destined for export.

## **Procedures to Achieve These Objectives –**

### Plant survey and Product selection for analysis

Five plants were selected for participation. Samples were collected from products, the environment and product contact surfaces. All samples were transported to the University of Kentucky's Food System Innovation Center for analysis.

Pork variety meat samples (Lungs, Livers, Hearts and Kidneys) were obtained from the carcass prior to evisceration and from the offal trays/packaging. Products were analyzed for Salmonella, Campylobacter, E. coli and aerobic plate counts to determine baseline microflora.

In addition, environmental water samples were collected along with scalding fluid as well as food contact surface samples. All samples were evaluated at a minimum of three times during the day to ascertain potential microbial buildup throughout the day.

### Microbiological and chemical analyses

Products ( $20 \pm 2$  g each) were added to 180 ml of sterile 0.10% (w/v) peptone water (PW) in a sterile stomacher bag and homogenized for 1 minute in a stomacher. Appropriate dilutions in PW were surface plated on XLD agar to quantify Salmonella population. After incubation at 37°C for 24 hours, viable colonies were counted and reported as log<sub>10</sub> CFU/g of the sample. Experiments were replicated twice with different samples and analyses run in duplicates for each replicate.

All procedures for microbial sampling and analysis were performed according to FDA's BAM references and were validated before the start of the project by USDA's technical center to assure acceptability. All investigators have ample knowledge of approved practices and Dr Newman, in charge of the Microbiological work, has managed a private industry food testing lab previously and currently is the Director of the Food Systems Innovation Center at the University of Kentucky which regularly conducts validation studies for the food industry. In addition, Dr. Mikel is recognized by USDA as a process authority and has been involved in numerous validation studies for the industry.

## Results:

Table 1. Pork Plant Offal Survey Data									
Plant 1	Environmental					Tissue			
	E. coli	T coliform	T 37	Salmonella	Sal. enrichment	Salmonella	Sal enrichment	T37	Campylobacter
1111	<10	<10	2.10E+02	<100	neg				pos/ neg
	<10	<10	2.20E+02	<100	neg				
2222	1.00E+01	3.00E+01	2.90E+03	<100	neg				
	<10	<10	2.96E+03	<100	neg				
3333	3.00E+01	3.00E+01	1.19E+03	<100	neg				
	<10	<10	1.20E+03	<100	neg				
4444	<10	<10	1.30E+02	<100	neg				
	<10	<10	2.00E+02	<100	neg				
1VL	<10	<10	1.01E+03	<100	neg	<10	neg	2.03E+02	neg
	<10	<10	1.08E+03	<100	neg	<10		4.06E+02	
1VH	2.00E+01	2.00E+01	8.90E+02	<100	neg	<10	neg	<10	neg
	<10	<10	9.00E+02	<100	neg	<10		<10	
1VG	1.00E+01	1.00E+01	2.80E+03	<100	neg	<10	neg	2.03E+02	neg
	2.00E+02	2.00E+02	2.83E+03	<100	neg	<10		2.03E+02	
1VK	5.00E+01	2.20E+02	1.01E+03	<100	neg	<10	neg	2.03E+02	neg
	1.00E+01	2.00E+01	1.22E+03	<100	neg	<10		2.03E+02	
2 VL	1.00E+01	1.00E+01	2.44E+03	<100	neg	<10	pos	6.10E+02	neg
	1.00E+01	1.00E+01	2.55E+03	<100	neg	<10		1.02E+03	
2VH	<10	<10	7.00E+02	<100	neg	<10	neg	<10	neg
	<10	<10	8.10E+02	<100	neg	<10		<10	
2VG	<10	<10	1.07E+03	<100	neg	<10	neg	4.07E+02	neg
	<10	1.00E+01	1.19E+03	<100	neg	<10		<10	
2VK	1.00E+01	1.00E+01	5.90E+02	10	pos	<10	neg	1.22E+03	neg
	1.00E+01	1.00E+01	4.40E+02	<100	neg	<10		8.13E+02	
3VL	<10	<10	2.18E+03	<100	neg	<10	neg	4.06E+02	pos
	1.00E+01	1.00E+01	1.80E+03	<100	neg	<10		<10	
3VH	<10	<10	5.50E+02	<100	neg	<10	neg	2.03E+02	pos
	1.00E+01	1.00E+01	5.50E+02	<100	neg	<10		<10	
3VG	1.00E+01	1.00E+01	1.08E+03	<100	neg	<10	neg	2.03E+02	pos
	1.00E+01	1.00E+01	1.10E+03	<100	neg	<10		2.03E+02	
3VK	8.00E+01	2.00E+02	1.74E+03	<100	neg	<10	neg	4.07E+02	neg
	7.00E+01	1.10E+02	1.93E+03	<100	neg	<10		4.07E+02	
4VL	6.00E+01	6.70E+02	2.84E+03	<100	neg	<10	neg	4.07E+02	pos
	7.00E+01	8.50E+02	2.75E+03	<100	neg	<10		4.07E+02	
4VH	<10	2.00E+01	2.00E+03	<100	neg	<10	neg	2.03E+02	pos
	<10	1.00E+01	2.20E+03	10	pos	<10		<10	
4VG	<10	<10	6.00E+02	<100	neg	<10	neg	2.03E+02	pos
	<10	<10	7.30E+02	<100	neg	<10		<10	
4VK	1.40E+02	8.00E+02	2.73E+03	<100	neg	<10	neg	2.03E+02	pos

	6.00E+01	8.40E+02	2.55E+03	<100	neg	<10		<10	
<b>Plant 2</b>	<b>Environmental</b>					<b>Tissue</b>			
						Salmonella	Sal enrichment	T37	Campylobacter
	E. coli	T coliform	T 37	Salmonella	Sal. enrichment				pos/ neg
SF1 water	<10	<10	2.00E+02	<100	neg	pH 11.72			
	<10	<10	9.00E+02	<100	neg				
1111	<10	<10	1.70E+02	<100	neg				
	<10	<10	1.40E+02	<100	neg				
2222	<10	<10	2.40E+02	<100	neg				
	<10	<10	1.70E+02	<100	neg				
3333	<10	<10	7.00E+01	<100	neg				
	<10	<10	1.10E+02	<100	neg				
4444	<10	<10	2.00E+01	<100	neg				
	<10	<10	8.00E+01	<100	neg				
1VL	1.30E+02	1.40E+02	2.80E+03	<100	neg	<10	neg	<10	neg
	1.40E+02	1.40E+02	3.30E+03	<100	neg	<10		7.56E+02	
1VH	<10	<10	3.00E+02	<100	neg	<10	neg	2.03E+02	neg
	<10	<10	3.00E+02	<100	neg	<10		<10	
1VG	<10	<10	<100	<100	neg	<10	neg	<10	neg
	<10	<10	<100	<100	neg	<10		<10	
1VK	<10	<10	7.00E+02	<100	neg	<10	neg	2.03E+02	neg
	<10	<10	1.00E+03	<100	neg	<10		2.03E+02	
2 VL	<10	<10	1.00E+02	<100	neg	<10	neg	8.13E+02	neg
	<10	<10	<100	<100	neg	<10		4.07E+02	
2VH	<10	<10	3.50E+03	<100	neg	<10	neg	6.71E+03	neg
	<10	<10	2.80E+03	<100	neg	<10		6.30E+03	
2VG	<10	<10	6.00E+02	<100	neg	<10	pos	<10	neg
	<10	<10	2.00E+02	<100	neg	<10		<10	
2VK	2.00E+01	2.00E+01	3.20E+03	<100	neg	<10	neg	2.03E+02	neg
	1.00E+01	4.00E+01	3.20E+03	<100	neg	<10		<10	
3VL	<10	<10	5.00E+02	<100	neg	<10	neg	2.44E+03	neg
	<10	<10	8.00E+02	<100	neg	<10		2.85E+03	
3VH	<10	<10	2.00E+02	<100	neg	<10	neg	2.34E+04	neg
	<10	<10	3.00E+02	<100	neg	<10		2.11E+04	
3VG	<10	<10	<100	<100	neg	<10	neg	1.42E+03	neg
	<10	<10	<100	<100	neg	<10		6.10E+02	
3VK	1.00E+01	1.00E+01	4.00E+02	<100	neg	<10	neg	2.03E+03	neg
	<10	<10	7.00E+02	<100	neg	<10		4.27E+03	
4VL	<10	1.00E+01	1.50E+03	<100	neg	<10	neg	5.08E+03	neg
	<10	<10	1.40E+03	<100	neg	<10		5.08E+03	
4VH	<10	<10	4.00E+02	<100	neg	<10	neg	1.48E+04	neg
	<10	<10	1.50E+03	<100	neg	<10		8.94E+03	
4VG	<10	<10	4.00E+02	<100	neg	<10	pos	<10	neg

	<10	<10	4.00E+02	<100	neg	<10		<10	
4VK	1.00E+01	1.00E+01	4.90E+03	<100	neg	<10	neg	1.48E+04	neg
	<10	3.00E+01	6.00E+03	<100	neg	<10		8.94E+03	
<b>Plant 3</b>	<b>Environmental</b>					<b>Tissue</b>			
						Salmonella	Sal enrichment	T37	Campylobacter
	E. coli	T coliform	T 37	Salmonella	Sal. enrichment				pos/ neg
SF2 water	<10	<10	5.50E+03	<100	neg	pH 8.6			
	<10	<10	5.20E+03	<100	neg				
1VL	2.00E+01	2.00E+01	7.00E+01	<100	neg	<10	neg	<10	neg
	<10	<10	1.40E+02	<100	neg	<10		<10	
1VH	<10	<10	2.00E+01	<100	neg	<10	neg	<10	neg
	<10	<10	2.00E+01	<100	neg	<10		<10	
1VG	<10	<10	5.00E+01	<100	neg	<10	neg	8.13E+02	neg
	<10	<10	3.00E+01	<100	neg	<10		8.13E+02	
1VK	<10	<10	4.00E+01	<100	neg	<10	neg	<10	neg
	<10	<10	1.10E+02	<100	neg	<10		<10	
2 VL	<10	<10	1.10E+02	<100	neg	<10	neg	<10	neg
	<10	<10	4.00E+01	<100	neg	<10		<10	
2VH	<10	<10	7.00E+01	<100	neg	<10	pos	2.03E+02	neg
	<10	<10	7.00E+01	<100	neg	<10		4.07E+02	
2VG	<10	<10	4.00E+01	<100	neg	<10	neg	<10	neg
	<10	<10	8.00E+01	<100	neg	<10		<10	
2VK	1.00E+01	1.00E+01	2.20E+02	<100	neg	<10	neg	<10	neg
	2.00E+01	2.00E+01	1.90E+02	<100	neg	<10		<10	
3VL	7.00E+01	7.00E+01	7.50E+02	<100	neg	<10	neg	<10	neg
	8.00E+01	8.00E+01	8.70E+02	<100	neg	<10		<10	
3VH	<10	<10	1.90E+03	<100	neg	<10	neg	<10	neg
	<10	<10	4.20E+03	<100	neg	<10		<10	
3VG	<10	<10	2.00E+01	<100	neg	<10	neg	<10	neg
	<10	<10	1.10E+02	<100	neg	<10		<10	
3VK	<10	<10	6.00E+01	<100	neg	<10	neg	<10	neg
	<10	<10	1.20E+02	<100	neg	<10		<10	
4VL	4.00E+01	4.00E+01	1.80E+02	<100	neg	<10	neg	<10	neg
	2.00E+01	2.00E+01	2.20E+02	<100	neg	<10		<10	
4VH	<10	<10	5.30E+03	<100	neg	<10	neg	<10	neg
	<10	<10	3.10E+03	<100	neg	<10		<10	
4VG	3.68E+03	4.30E+03	1.51E+04	<100	neg	<10	pos	<10	neg
	4.34E+03	5.52E+03	1.45E+04	<100	neg	<10		<10	
4VK	4.00E+01	4.00E+01	1.90E+02	<100	neg	<10	neg	2.03E+02	neg
	<10	<10	2.20E+02	<100	neg	<10		<10	
<b>Plant 4</b>	<b>Environmental</b>					<b>Tissue</b>			

	E. coli	T coliform	T 37	Salmonella	Sal. enrichment	Salmonella	Sal enrichment	T37	Campylobacter
1111	<10	<10	1.00E+01	<100	neg				pos/ neg
	3.00E+01	3.00E+01	<10	<100					
2222	<10	<10	2.00E+02	<100	neg				
	<10	<10	1.00E+02	<100					
3333	<10	<10	3.00E+01	<100	neg				
	<10	<10	<10	<100					
4444	6.00E+01	6.00E+01	1.00E+02	<100	pos.				
	3.00E+01	3.00E+01	1.40E+02	<100					
1VL	5.00E+01	1.80E+02	6.70E+02	<100	neg	<10	neg	<10	neg
	3.00E+01	2.00E+02	6.20E+02	<100		<10		2.03E+02	
1VH	4.00E+01	7.00E+01	4.20E+02	<100	neg	<10	neg	<10	pos
	6.00E+01	8.00E+01	5.60E+02	<100		<10		<10	
1VG	3.44E+03	4.62E+03	4.40E+04	<100	pos.	<10	neg	1.22E+03	pos
	3.74E+03	4.62E+03	4.95E+04	2.00E+02		<10		1.22E+03	
1VK	1.00E+01	2.00E+01	1.10E+02	<100	neg	<10	pos	<10	pos
	1.00E+01	2.00E+01	1.10E+02	<100		<10		6.10E+02	
2 VL	5.00E+01	6.00E+01	7.70E+02	<100	neg	<10	neg	<10	neg
	1.00E+01	5.00E+01	8.20E+02	<100		<10		2.03E+03	
2VH	9.00E+01	1.10E+02	1.36E+03	<100	neg	<10	neg	6.10E+02	pos
	1.30E+02	1.40E+02	1.13E+03	<100		<10		4.07E+02	
2VG	7.20E+02	8.30E+02	8.00E+03	<100	neg	<10	neg	<10	pos
	7.50E+02	7.60E+02	8.00E+03	<100		<10		<10	
2VK	6.10E+02	6.90E+02	1.86E+03	<100	pos.	<10	neg	<10	pos
	5.80E+02	6.10E+02	1.84E+03	<100		<10		<10	
3VL	6.10E+02	7.20E+02	2.90E+03	<100	neg	<10	pos	2.03E+02	neg
	5.00E+02	6.50E+02	3.30E+03	<100		<10		2.03E+02	
3VH	5.00E+01	6.00E+01	5.60E+02	<100	neg	<10	neg	2.03E+02	neg
	4.00E+04	1.11E+03	8.10E+02	<100		<10		2.03E+02	
3VG	7.00E+01	8.00E+01	1.10E+03	<100	neg	<10	pos	<10	neg
	8.00E+01	9.00E+01	1.00E+03	<100		<10		<10	
3VK	5.00E+01	1.10E+04	2.06E+04	<100	neg	<10	pos	<10	neg
	4.00E+01	9.68E+03	2.18E+04	<100		<10		2.03E+02	
4VL	1.00E+01	7.00E+01	1.90E+02	<100	neg	<10	neg	<10	pos
	2.00E+01	1.80E+02	2.30E+02	<100		<10		<10	
4VH	7.00E+01	1.10E+02	5.20E+02	<100	neg	<10	neg	<10	neg
	1.00E+01	2.00E+01	5.00E+02	<100		<10		<10	
4VG	2.00E+01	5.00E+01	3.70E+02	<100	neg	<10	neg	2.03E+02	neg
	3.00E+01	6.00E+01	4.80E+02	<100		<10		<10	
4VK	<10	3.63E+03	8.20E+03	<100	neg.	<10	neg	2.03E+02	neg
	<10	2.75E+03	7.50E+03	<100		<10		<10	
<b>Plant 5</b>	<b>Environmental</b>					<b>Tissue</b>			
SF1 water	<10	<10	3.70E+02	<100	neg				

	<10	<10	4.10E+01	<100		Salmonella	Sal enrichment	T37	Campylobacter
1111	<10	<10	6.00E+01	<100	neg				pos/ neg
	<10	<10	1.20E+02	<100					
2222	<10	<10	2.00E+01	<100	neg				
	<10	<10	1.00E+01	<100					
3333	<10	<10	1.00E+01	<100	neg				
	<10	<10	<10	<100					
4444	<10	<10	1.00E+01	<100	neg				
	<10	<10	<10	<100					
1VL	<10	<10	<10	<100	neg	<10	neg	<10	neg
	<10	<10	<10	<100		<10		2.03E+02	
1VH	<10	<10	4.00E+01	<100	neg	<10	neg	1.02E+03	neg
	<10	<10	2.00E+01	<100		<10		6.10E+02	
1VG	<10	<10	8.00E+01	<100	neg.	<10	neg	4.07E+02	neg
	<10	<10	8.00E+01	<100		<10		2.03E+02	
1VK	<10	<10	<10	<100	neg	<10	neg	<10	neg
	<10	<10	<10	<100		<10		4.07E+02	
2 VL	<10	<10	4.20E+02	<100	neg	<10	neg	<10	neg
	<10	<10	4.80E+02	<100		<10		<10	
2VH	1.00E+01	1.00E+01	1.00E+02	<100	neg.	<10	neg	<10	neg
	<10	<10	1.70E+02	<100		<10		<10	
2VG	<10	<10	4.30E+02	<100	pos.	<10	pos	<10	neg
	<10	<10	4.40E+02	<100		<10		<10	
2VK	<10	<10	1.00E+01	<100	neg	<10	neg	4.07E+02	neg
	<10	<10	<10	<100		<10		2.03E+02	
3VL	<10	<10	4.00E+01	<100	neg	<10	pos	1.02E+03	neg
	<10	<10	2.00E+01	<100		<10		2.03E+02	
3VH	<10	<10	1.40E+02	<100	neg.	<10	pos	2.03E+02	neg
	<10	<10	8.00E+01	<100		<10		2.03E+02	
3VG	<10	<10	3.90E+03	<100	neg	<10	neg	2.03E+02	neg
	<10	<10	3.70E+03	<100		<10		<10	
3VK	1.00E+01	1.00E+01	2.00E+02	<100	neg	<10	neg	<10	neg
	<10	<10	2.40E+02	<100		<10		8.13E+02	
4VL	<10	<10	1.10E+02	<100	neg.	<10	pos	<10	neg
	<10	<10	6.00E+01	<100		<10		<10	
4VH	<10	2.00E+01	6.00E+01	<100	neg	<10	pos	2.03E+02	neg
	<10	<10	2.00E+01	<100		<10		<10	
4VG	<10	<10	1.00E+01	<100	neg	<10	neg	2.03E+02	neg
	<10	<10	2.00E+01	<100		<10		<10	
4VK	<10	1.00E+01	1.60E+02	<100	neg.	<10	neg	4.07E+02	neg
	<10	<10	1.00E+02	<100		<10		<10	

Table 2. Salmonella Positives per Plant, Operation Type, or Organ.					
		Environmental		Tissue	
Plant	Type	Sal Pos.		Sal Pos.	Campy Pos
1	Skin	2		1	7
2	Scald	0		2	0
3	Scald	0		2	0
4	Skin	3		4	7
5	Scald	1		5	0
<b>Total</b>		<b>6</b>		<b>14</b>	<b>14</b>
<b>Avg</b>		<b>1.2</b>		<b>2.8</b>	<b>2.8</b>
Liver		0		4	3
Heart		1		3	4
Kidney		2		2	3
Lungs		2		5	4

**Discussion:**

The recent scenario indicated for every \$1 million of variety meat exported, live hog value increases by \$0.20/CWT and the industry exports less than 10% of these products then a tremendous economic opportunity exist for the US pork industry. As the US pork industry searches to capitalize on this little valued by-product that the majority of the world has commonly accepted as a readily consumable animal protein source, it needs only determine a way to assure the safety and extend the shelf life of products destined for export. In order to capitalize on such an opportunity the US pork industry must be able to document the safety and shelflife of the variety meats it produces for export. The present study indicates that products are less contaminated immediate after venting before products are removed from the carcass and exposed to potential environmental cross contamination. However, situation may arise that lead to increased contamination once the product is exposed. Diligence is necessary to ensure that proper sanitation of product contact surfaces occurs to minimize the risk of possible cross contamination.