

# ***Salmonella* enterica prevalence and serotype distribution in lymph nodes from market swine**

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## **ABSTRACT**

The objective of this study was to determine the potential for lymph nodes to contribute *Salmonella* in ground pork and the magnitude of *Salmonella* load attributable to lymph nodes. Four lymph nodes were selected for this exploration: Mandibular, Superficial Inguinal, Superficial Popliteal and Medial Iliac based on literature review. A total of 1,552 lymph nodes were collected from market-age swine at a Midwest processing facility at four times over the course of a year. Overall, Mandibular nodes showed a notably higher prevalence than the other nodes; 9.8% compared to 3.8% for Superficial popliteal, 3.4% for Superficial inguinal, and 1.8% for Medial Iliac. The *Salmonella* load was below 0.66 log<sub>10</sub> MPN/g for 75% of positive nodes; the highest *Salmonella* loads were observed in the Superficial Inguinal (3.9 and 3.7 log<sub>10</sub> MPN/g). Derby, Enteritidis, and Typhimurium were the most common serotypes identified. Derby was identified in all study phases, Enteritidis was identified only in the first phase and was found in each node type, and Typhimurium was identified in three phases but only in the Mandibular lymph nodes. This study demonstrates that *Salmonella* prevalence, enumeration and serotypes vary for each lymph node sampled and across seasons.

## **INTRODUCTION**

The USDA/FSIS has proposed new *Salmonella* standards for intact/non-intact pork cuts and for raw, comminuted pork. The goal of these new standards is to reduce *Salmonella* in raw pork products. Studies are needed to understand where the contribution of *Salmonella* is coming from and to determine interventions. In commercial processing facilities, many, if not all interventions are based on reducing and eliminating surface contamination of the carcass. These processes have shown tremendous success in reducing food borne pathogens. Ground pork products continue to be of concern for *Salmonella* contamination. Lymph nodes act as a filtration system to destroy contaminants such as bacteria within the body of the animal. Processing these lymph nodes can potentially become part of ground product and serve as a potential point source of contamination. The objective of this study was to understand the potential for lymph nodes to contribute *Salmonella* in ground pork and determine the magnitude of *Salmonella* load attributable to lymph nodes.

## **MATERIAL AND METHODS**

Four lymph nodes were selected for sampling: Mandibular, Superficial Inguinal, Superficial Popliteal and Medial Iliac. Mandibular Lymph Node were collected in the head room. Medial Iliac Lymph Nodes were collected on the loin line. Superficial Inguinal Lymph Nodes were collected on the ham line. Superficial Popliteal Lymph Nodes were collected on the Ham line.

Samples were collected in four phases throughout the year. Phase I collection was conducted in the Spring. Phase II collection was in the Summer. Phase III collection was in the Fall and Phase IV collection in the Winter. Lymph nodes were collected over a four-day period with three collection times per day. For each lymph node, a total of 8 nodes were collected at each collection time except for the last collection with 9 for a total of 97 of each type: 388 total lymph nodes for each sampling phase. A total of 1,552 lymph nodes were collected for the entire study.

Lymph node samples were tested for *Salmonella* presence and confirmation using dual enrichment and direct plating followed by PCR confirmation. Positive samples were enumerated using the MPN methodology and serotypes were identified by CRISPR analysis.

## RESULTS

Overall, 4.7% of lymph nodes tested positive for *Salmonella*. The sample count and prevalence rates by phase and node are shown in Table 1 and the bar charts in **Error! Reference source not found.** show the prevalence rates and 95% confidence intervals by node type and phase. Lymph node prevalence rates across phases ranged from 0% to 13.4%. The highest prevalence was observed in the Mandibular at 13.4% in Phase I. The Superficial Inguinal, Superficial Popliteal and Medial Iliac lymph nodes had phases where 0% *Salmonella* prevalence was observed.

**Table 1. *Salmonella* prevalence in Lymph Nodes by Node and Phase**

Lymph Node	All phases	Phase			
		I	II	III	IV
Mandibular	9.8% (38/388)	13.4% (13/97)	10.3% (10/97)	3.1% (3/97)	12.4% (12/97)
Superficial Popliteal	3.9% (15/388)	9.3% (9/97)	4.1% (4/97)	2.1% (2/97)	0.0% (0/97)
Superficial Inguinal	3.4% (13/387)	11.3% (11/97)	1.0% (1/97)	1.0% (1/97)	0.0% (0/96)
Medial Iliac	1.8% (7/388)	4.1% (4/97)	3.1% (3/97)	0.0% (0/97)	0.0% (0/97)
<i>All</i>	4.7% (73/1,551)	9.5% (37/388)	4.6% (18/388)	1.5% (6/388)	3.1% (12/387)

The Superficial Inguinal had the highest level of *Salmonella*. All samples enumerated above 1log<sub>10</sub> MPN/g were collected in Phase I of the study. The enumeration results are provided in Table 2.

**Table 2. Count of Samples by Node and Load Breaks**

Node	Total positives	Log <sub>10</sub> MPN/g (count of samples)			
		<1	1-2	2-3	3-4
Mandibular	38	34	2	2	
Superficial Popliteal	15	13	1	1	
Superficial Inguinal	13	6	1	4	2
Medial Iliac	7	7			

The greatest diversity of *Salmonella* serotypes was found in Phase I (7 types). *Salmonella* serotype Enteritidis was isolated in only Phase I in multiple lymph nodes but not in any other phases. Derby was identified in all four phases of sampling and across multiple nodes.

Typhimurium and Agona were found in multiple phases but only in the Mandibular lymph node samples. No isolates were available for typing in 11 samples (mostly from low enumeration samples).

Serotype	Samples	Count of nodes			Medial Iliac	Superficial Popliteal	Sampling phases
		Inguinal	Mandibular	Superficial			
Enteritidis	12	6	1	1	4	I	
Derby	12	1	8		3	I,II,III,IV	
Typhimurium	12		12			I,II,IV	
Uganda	9	3	3	1	2	I	
Agona	9		9			II,III,IV	
Koessen	7	1	3	2	1	II,IV	
Infantis	3	1	2			I	
Manhattan	2		2			II	
Montevideo	1		1			I	
Unknown	2		1		1	I, III	

## DISCUSSION

This study is investigating an alternative route of potential contamination through the peripheral lymph nodes. Previous study have shown low levels of *Salmonella* contamination in ground pork (Broadway et. al, 2021). The Mandibular lymph node has been shown to be consistently above 10% prevalence (Vieira-Pinto et al., 2005; Chaves et al., 2017; Harvey et al., 2020). *Salmonella* contamination can also be part of the head and cheek meat intended for ground pork and may contribute to their high *Salmonella* prevalence (Harvey et al., 2017). Mesenteric lymph nodes have shown a varying range of *Salmonella* prevalence across market hogs and sows (Chaves et al., 2017).

## CONCLUSIONS

This was one study where samples were taken once in each quarter of the year. The public health risk of *Salmonella* in ground pork based on these lymph nodes is low, due to the low prevalence and level. More research is needed to find other lymph nodes that may contribute a higher risk for ground pork.

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