

## 4. RESULTS

### 4.1. Aerobic plate counts (APCs)

The aerobic plate counts were obtained by culturing pooled samples taken by sponge swabs from the back, jowl, ham and belly of the 62 pig carcasses. Histogram of the  $\text{Log}_{10}\text{cfu}$  of APCs per  $\text{cm}^2$  are presented in Figure 4.1. Generally, the  $\text{Log}_{10}\text{cfu}/\text{cm}^2$  of APCs ranged from 4.4 to 4.9 with a mean of 4.70  $\text{Log}_{10}\text{cfu}/\text{cm}^2$  in Swab1. In Swab2, these ranged from 4.5 to 5.3 with a mean of 4.85  $\text{Log}_{10}\text{cfu}/\text{cm}^2$ . The  $\text{Log}_{10}\text{cfu}/\text{cm}^2$  in Swab2 had the largest variability and many outliers. Overall, the difference between the  $\text{Log}_{10}\text{cfu}/\text{cm}^2$  of two swabs was significant ( $p=0.0001$ ).

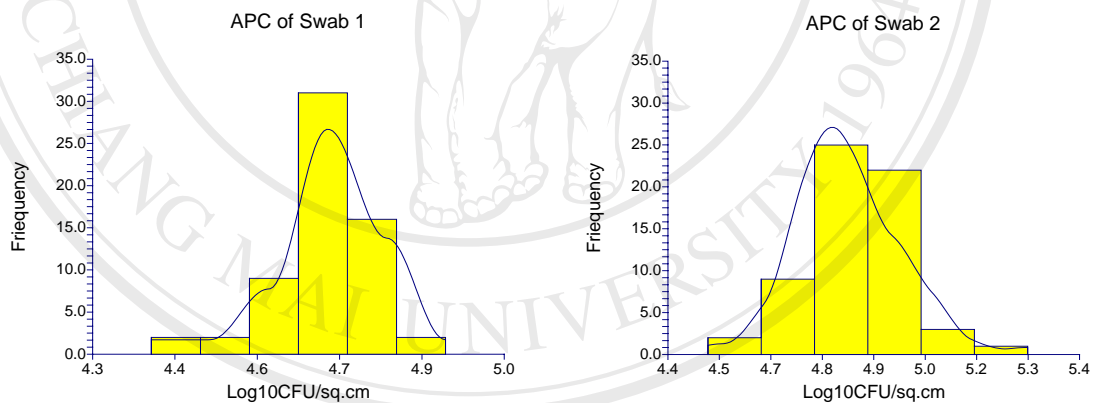


Figure 4.1: Histograms of  $\text{log}_{10}\text{cfu}/\text{cm}^2$  of aerobic plate counts of pig carcasses in the Dorn Du slaughterhouse, 2004 – 2005.

#### 4.2. *Enterobacteriaceae* counts (EBCs)

The *Enterobacteriaceae* counts (EBCs) were obtained by culturing pooled samples taken by sponge swabs from the back, jowl, ham and belly areas of 62 pig carcasses. Figure 4.2 shows Box-and-Whisker plots of the  $\text{Log}_{10}\text{cfu}$  of *Enterobacteriaceae* counts per  $\text{cm}^2$  ( $\text{Log}_{10}\text{cfu}/\text{cm}^2$ ). In Swab1, the  $\text{Log}_{10}\text{cfu}$  of EBCs ranged from 2.3 (an outlier) to 3.1 with a mean of 2.81 and a median of 2.8, whereas, Swab2 had values of  $\text{Log}_{10}\text{cfu}$  of EBCs that ranged from 2.1 (an outlier) to 3.3 with a mean of 2.98 and a median of 3.0. Visually, many values in Swab2 were negatively skewed. Overall, the  $\text{Log}_{10}\text{cfu}/\text{cm}^2$  of EBCs were significantly ( $p=0.0001$ ) different between Swab1 and Swab2.

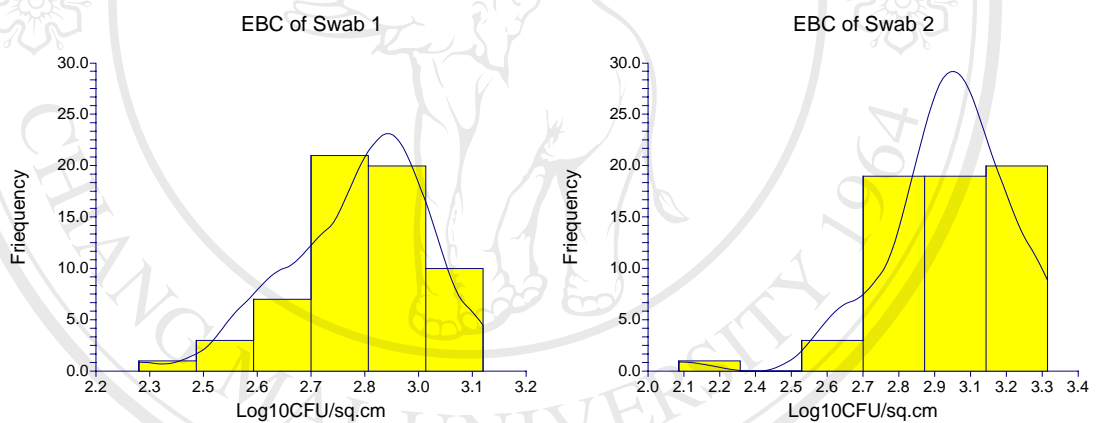


Figure 4.2: Histograms of  $\text{log}_{10}\text{cfu}/\text{cm}^2$  of *Enterobacteriaceae* counts of pig carcasses in the Dorn Du slaughterhouse, 2004 – 2005;

### 4.3. *Salmonella* detection and Identification

#### 4.3.1. *Salmonella* isolation

A total number of 186 samples were collected from 62 pig carcasses over the study period and examined for *Salmonella*. Three samples were collected from each randomly selected carcass (Swab1, Swab2 and mesenteric lymph node (MLN)). Table 4.1 shows the prevalence of *Salmonella* obtained from each type of sample. In all of the samples, 55.4% (95% CI: 47.9-62.6) were *Salmonella* positive. *Salmonella* was found more frequently (66.1%, 95% CI: 52.9 - 77.4) in Swab2, followed by 53.2% (95% CI: 40.2 - 65.8) in MLN and lowest in 46.8% (95% CI: 34.2 - 59.8) in Swab1. No significant ( $P=0.088$ ) differences were observed among these prevalences.

Table 4.1: Prevalence of *Salmonella* in Swab1 and Swab2, and Mesenteric lymph nodes of pig carcasses at “Dorn DU” Slaughterhouse.

Sample type	n	Positive	Prevalence (%)	95% CI
Swab1	62	29	46.8	34.2 - 59.8
Swab2	62	41	66.1	52.9 - 77.4
MLN	62	33	53.2	40.2 - 65.8
Overall	186	103	55.4	47.93 - 62.6

$n$  = number of sample

CI = Confidence interval

MLN = mesenteric lymph node

#### 4.3.2. Pre-harvest *Salmonella*

Table 4.2 shows the results of the univariate analyses of the potential risk factors and occurrence of *Salmonella* in mesenteric lymph nodes. There was a significant association (OR=2.15, 95% CI: 0.76-6.07, P= 0.19) between the presence of *Salmonella* in mesenteric lymph nodes and transportation time: more than 4 hours of transportation had higher prevalence those less than 4 hours. But, herd size greater than 500, water sources and sources of piglets had odds ratios of less than one. Herd size greater than 500 had a higher sample prevalence compared to small sized herds. Thus, it was 2.9 (1/OR) times of having *Salmonella* isolated from mesenteric lymph nodes. Similarly, “other water sources” and sources of piglets outside the farms were 3.3 and 4.5 times, respectively; of having *Salmonella* isolated from mesenteric lymph nodes.

Table 4.2: Summary results of univariate analysis on association between *Salmonella* isolation from Mesenteric lymph nodes and various potential risk factors

Risk factor	Sample	Positive sample	% Positive	OR (95% CI)	$\chi^2$ corrected (P-value)
<b>Herd Size</b>					
<500	32	13	41	0.34	3.24
>500	30	20	67	(0.11-1.09)	0.0072
<b>Transportation time</b>					
>4hrs	38	23	61	2.15	1.41
<4hrs	24	10	42	(0.67-6.95)	0.2346
<b>Water Source</b>					
Tab water	38	16	42	0.30	3.79
Others*	24	17	71	(0.09-1.01)	0.05154
<b>Sources of piglets</b>					
Within farm	38	15	39	0.22	6.10
Outside farm	24	18	47	(0.06-0.76)	0.0135

$n$  = number of samples (MLN) with *Salmonella* positive

OR= Odds Ratio

p = p-value

\*Underground and surface water

The summary results of the multiple logistic regression analysis of the potential risk factors that were significantly associated with *Salmonella* isolations from mesenteric lymph nodes in the univariate analysis are shown in Table 4.3. The multiple logistic regression model obtained was:

Logit (p/1-p) = -0.4938 + 0.3698 (Herd size) + 1.717 (Source of piglets) – 0.487 (Source of water):

Log-likelihood = -38.789, df 3, p = 0.044;

Goodness of-fit-Tests			
Method	Chi-square	DF	p-value
Pearson	2.202	2	0.333
Deviance	2.888	2	0.236
Hosmer-Lemeshow	0.947	2	0.623

The model fitted the data (p = 0.333).

The source of piglets was strongly associated despite the fact that its OR = 5.57 was not statistically significant (p = 0.160). The rest of the risk factors gave low ORs.

Table 4.3: Summary results of multiple logistic regression analysis for the associations between *Salmonella* isolation from Mesenteric lymph nodes and various potential risk factors

Risk factor	Sample	Positive sample	% Positive	OR (95% CI)	P-value
<b>Herd Size</b>					
<500	32	13	41	1.45	0.590
>500	30	20	67	(0.38-5.56)	
<b>Water Source</b>					
Tab water	38	16	42	0.61	0.687
Others*	24	17	71	(0.06-6.58)	
<b>Sources of piglets</b>					
Within farm	38	15	39	5.57 (0.51-61.04)	0.160
Outside farm	24	18	47		

Table 4.4: Proportions of *Salmonella* isolation from Swabs1, Swabs2 and mesenteric lymph nodes from pork carcasses in the Dorn Du slaughterhouse

<i>n</i>	Swab1	MLN	Swab2	Proportion (%)
6	+	+	+	9,7
6	+	+	-	9,7
13	-	+	+	21,0
11	+	-	+	17,7
6	+	-	-	9,7
8	-	+	-	12,9
11	-	-	+	17,7
1	-	-	-	1,6
62				100.0

+ = *Salmonella* positive; - = *Salmonella* negative

MLN = Mesenteric lymph node

$n$  = Number of pigs with salmonella positive result.

Table 4.4 shows the distribution of samples positive for *Salmonella*. Of all different samples collected from the 62 pork carcasses, 9.7% were positive for *Salmonella*. Swab1 and MLN were both positive in 9.7% of the carcasses while MLN and Swab2 were positive in 21.0% of the carcasses. Swab1 and Swab2, as the indicator of carcass contamination with *Salmonella* and slaughterhouse hygiene, were isolated in 17.7% of all carcasses.

#### 4.3.3. Serotyping

Out of 103 isolates, 26.2% belonged to Somatic group B, 29.1% to group C, 42.7% to group E and 1.9% to group D (Table 4.5). Totally eight different serotypes were obtained (Table 4.6). The most frequent (29,1 %) serotype was *Salmonella* Rissen, followed by *S. Anatum* (27.2%), *S. Derby* (19.4%), and *S. Elisabethville* (7.8%). The other serotypes identified were *S. Amsterdam* (7.8%), *S. Typhimurium* (3.9%), *S. Agona* (2.9%), and *S. Enteritidis* (1.9 %). These serotypes were found in all types of samples, except the last one, (*S. Enteritidis*), which was isolated from Swab2 only.

Table 4.5: *Salmonella* Somatic (O) group in carcass Swab1 and Swab2 and mesenteric lymph nodes

Sample	Somatic (O) group				Total
	B	C	D	E	
Swab1	8* (27.6)	11 (37.9)	-	10 (34.5)	29 (100.0)
MLN	11 (33.3)	10 (30.3)	-	12 (36.4)	33 (100.0)
Swab2	8 (19.5)	9 (22.0)	2 (4.9)	22 (53.7)	41 (100.0)
Overall	27 (26.2)	30 (29.1)	2 (1.9)	44 (42.7)	103 (100.0)

( ) = Percentage;

\* = number of samples with positive *Salmonella* result

MLN = Mesenteric lymph node

Table 4.6: *Salmonella* serotypes in carcass Swab1 and Swab2 and Mesenteric lymph nodes

<i>Salmonella</i> serovar	Number of strains	%
<i>S. Rissen</i>	30	29.1
<i>S. Anatum</i>	28	27.2
<i>S. Derby</i>	20	19.4
<i>S. Elisabethville</i>	8	7.8
<i>S. Amsterdam</i>	8	7.8
<i>S. Typhomurium</i>	4	3.9
<i>S. Agona</i>	3	2.9
<i>S. Enteritidis</i>	2	1.9
Total	103	100.0