4. RESULTS

4.1 Result of *Salmonella* isolation and serotyping

4.1.1 Result of *Salmonella* isolation

Table 10 shows the frequency of *Salmonella* isolates after delivery from breeder sows in both housing systems. All isolates were found in faecal samples and few samples were positive (Figure 6).

Table 11 shows the frequency of *Salmonella* isolates after delivery from environmental samples in both housing systems. The result showed three positive samples isolated from pen swabs. The most *Salmonella* positive found at day 1 after delivery (33.33%).

Table 12 shows the percent proportion of *Salmonella* isolates from sows and environmental samples compared between open and close house. The proportions of *Salmonella* isolates in sows from open and closed housing system were identical (20%). The proportion of salmonella isolates in environment of open housing system (22.22%) was higher than close housing system (11.11%).

Table 10: Distribution of *Salmonella* isolates from sow by date

Housing system	Sows number	**Day 1**	**Day 7**	**Day 18**
Open house	S1	-	-	-
	S2	-	-	-
	S3	-	-	-
	S4	-	-	-
	S5	-	-	-
	S6	-	-	-
	S7	**+(feces)**	-	-
	S8	-	-	-
	S9	-	-	-
	S10	-	-	**+(feces)**
Close house	S11	-	-	-
	S12	-	-	-
	S13	-	**+(feces)**	-
	S14	-	-	-
	S15	-	-	-
	S16	-	-	-
	S17	-	-	-
	S18	**+(feces)**	-	-
	S19	-	-	-
	S20	-	-	-
Total	20 sows	2	1	1
Percentage		10%	5%	5%

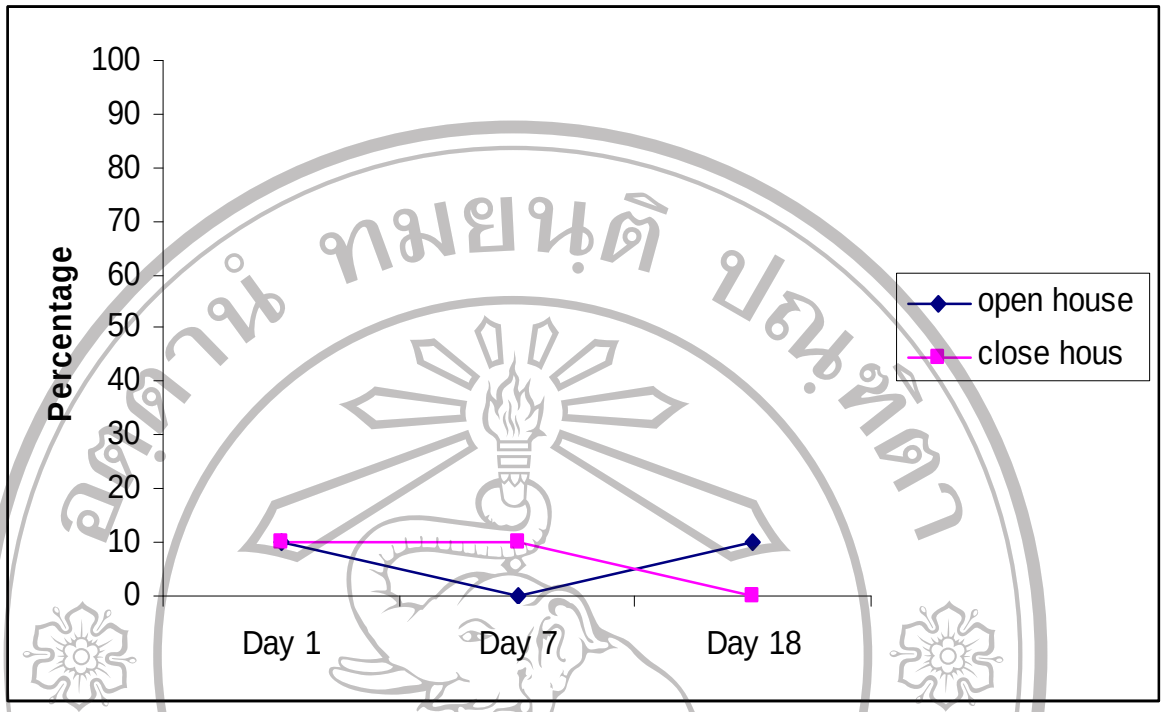

Figure 6: *Salmonella* positive in sow samples: open and close housing systems

Table 11: Distribution of *Salmonella* isolates from environmental samples by date

Housing system	Sows number	**Day 1**	**Day 7**	**Day 18**
Open house	Feed	-	-	-
	Water	-	-	-
	Pen swab	+	+	-
Close house	Feed	-	-	-
	Water	-	-	-
	Pen swab	+	-	-
Total		2	1	0
Percentage		33.33%	16.67%	0

+ = positive result

- = negative result

Table 12: Proportion of *Salmonella* isolates in sows and environmental samples in comparison of open and close housing systems

Factors	**Samples**	**Total samples**	**No. positive**	% proportion (95% CI)
Open house	Sows	10	2	20 (3.54-55.78)
	Environmental samples	9	2	22.22 (3.95-59.81)
Close house	Sows	10	2	20 (3.54-55.78)
	Environmental samples	9	1	11.11 (0.5849.33)

4.1.2 Result of *Salmonella* serotyping

Table 13 shows the frequently found *Salmonella* serogroup in breeder sows and environmental samples, *Salmonella* serogroup C was the highest proportion 57.14 % followed by group II (14.28%) group B (14.28%) and *Salmonella* rough strain (14.28) The serogroups found in open and closed housing systems were basically the same.

Overall, the 8 *Salmonella* positive samples found were *S*. Rissen (57.14 %) followed by group F-67 (14.28%), *S*. Stanley (14.28%) as shown in Table 14.

Distribution of *Salmonella* serotypes in open and close housing system indicated that *S.* Rissen was the most frequently (28.57 %) serotype as same as the comparison between groups of samples detail in Table 15 and 16.

Table 17 shows the distribution of *Salmonella* serotypes in open and close housing system by date. Three of four samples at day 1 after delivery were *S.* Rissen and another was *Salmonella* serotypes in group II (F-67). Two positive samples at day 7 after delivery were serotypes *S.* Rissen and *S.* Stanley, and one sample at day 18 was *Salmonella* rough strain. The most frequent day found *Salmonella* positive was day 1 (57.14%) followed by day 7 (28.57%) and day 18 (14.28%) after delivery.

Table 13: Serogroups of *Salmonella* from positive samples

Type of samples	Salmonella serogroup			
	B	C	II	Rough strain
Sows	1	2	-	1
Environmental	-	2	1	-
% Proportion	14.28 (1/7)	57.14 (4/7)	14.28 (1/7)	14.28 (1/7)

Table 14: Distribution of *Salmonella* serotypes

Serogroup	Serotypes	No. of positive (N=8)	% positive	95% CI
C	*S.* Rissen	4	57.14	20.23-88.19
B	*S.* Stanley	1	14.28	0.75-57.99
II	F-67	1	14.28	0.75-57.99
-	Other(*Salmonella* rough strain)	1	14.28	0.75-57.99

Table 15: Distribution of serotypes of *Salmonella* isolates separated by housing

Serotypes	Open house	% proportion	Close house	% proportion
S. Rissen	2	28.57	2	28.57
S. Stanley	1	14.28	0	0
F-67	0	0	1	14.28

Table 16: Distribution of *Salmonella* serotypes by group of samples

Serotypes	Sows	% proportion	Environmental	% proportion
S. Rissen	2	28.57	2	28.57
S. Stanley	1	14.28	0	0
F-67	0	0	1	14.28

Table 17: Distribution of *Salmonella* serotypes in open and close housing systems by date

Housing system	Samples	Day 1	Day 7	Day 18
Open house				
	S7	*S.* Rissen	-	-
	S10	-	-	***Salmonella*** rough strain
	Pen swab (2)	*S.* Rissen	*S.* Rissen	-
Close house	S13	-	S. Stanley	-
	S18	*S.* Rissen	-	-
	Pen swab	F-67	-	-
Total positive	7	4	2	1
		57.14%	28.57%	14.28%

4.2 Incidence of *Salmonella* in breeder sows

Incidence of *Salmonella* from day 1 to 7 and day 7 to 18 after deliveries in open house were 0 % and 10 %, in close house were 11.11% and 0% respectively. The tendency of *Salmonella* incidence from day 7 to day 18 after delivery in sows from open housing system slightly increased. While, in sows from close housing system slightly decreased as shown in figure 7 and 8.

Incidence density described assessing and comparing the impact of *Salmonella* infection in the sow herd in both housing systems during periparturient period. The result in both housing showed, there were nearly the same percentage 0.62 (open house) and 0.66 (close house). Meaning, 6 of 1,000 sows will be infected with Salmonella during periparturient period.

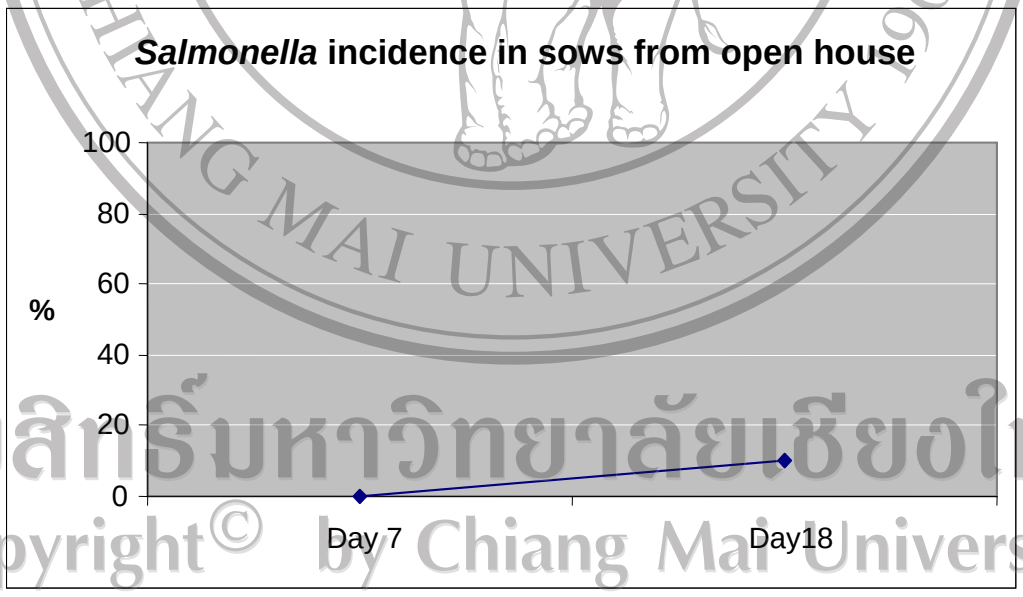

Figure 7: Incidence in breeder sows: open house

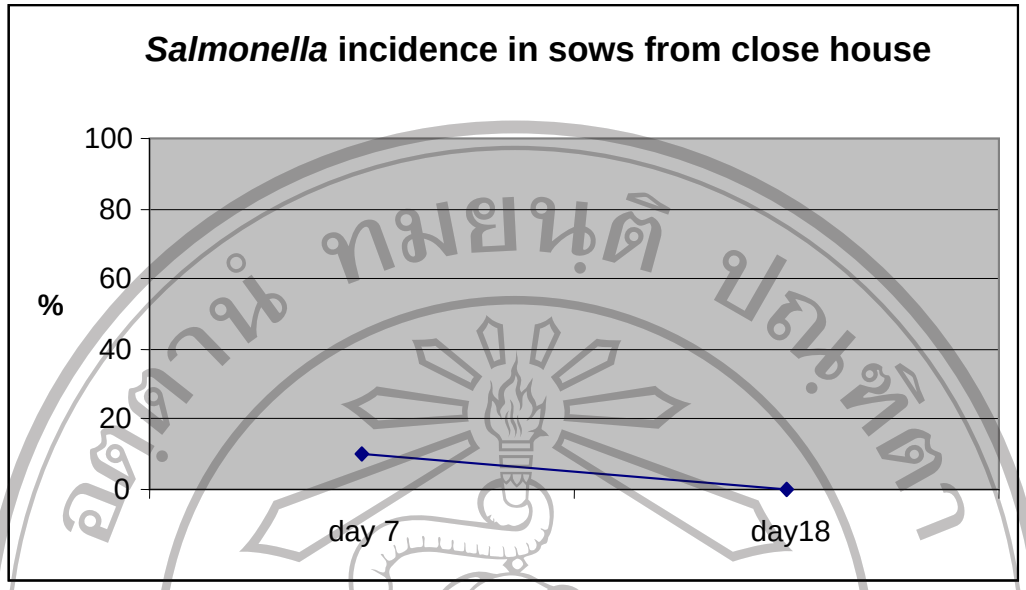

Figure 8: Incidence in breeder sows: close house

4.3 Result of *Salmonella* antibodies testing from serum samples

20 sera were tested for Salmonella antibodies by using Danish mix- ELISA. Base on an O.D.≥ 40%, the seroprevalence was 40 % (95% CI=19.98-63.59). Positive results were delivered from sows from the open housing systems (50%) and from sows from close housing system (30%).

Table 18 shows the comparison of ELISA results between open and close housing systems, found 50% (95% CI=20.14-79.86) and 30% (95% CI=8.09-64.63) were positive respectively. But, there was not significantly (p-value=0.648) difference.

Table 18: Serological results in comparison of open and close housing systems

Housing system	Serological results		% proportion (95% CI)
	Positive	Total samples	
Open	5	10	50 (20.14-79.86)
Close	3	10	30 (8.09-64.63)

4.4 Correlation between the number of *Salmonella* isolates and Danish mix-ELISA results

On the individual animal level, serological ELISA results were compared with the results of conventional *Salmonella* culture. Using the *Salmonella* isolation as the gold standard, sensitivity and specificity of the test were calculated using Win Episcope 2.0. Kappa statistics was used to assess an agreement between those two different methods (Table 19).

Table 19 shows the comparison between the culture results and ELISA result at the individual pig level without reference to housing system. Three of four positive culture samples tested positive by the ELISA giving a correlation of 75% (3/4). Eleven out of sixteen sera from the negative culture results tested negative by ELISA and five sera tested positive. Calculated Kappa values were 0.318, fair agreement mean it was poor correlation between conventional *Salmonella* culture method and ELISA testing. The test sensitivity and specificity were calculated to be 100% and 62.5% respectively.

Table 19**:** Comparison of *Salmonella* isolation and the serological results at the individual pig level

ELISA result	Salmonella Isolation		Grand Total
	positive	negative	
positive	3	5	8
negative	1	11	12
Grand Total	4	16	20

*ELISA Result (OD%≥ 40 = positive, OD %< 40 =negative)

		% Lower limit	Upper limit
Sensitivity of ELISA test	75.5	32.565	100
Specificity of ELISA test	68.75	46.038	91.462

Kappa statistics** (Epi Info 2002)

Observed proportion of agreement = 0.700

Expected proportion of agreement = 0.560

Observed minus chance agreement = 0.140

Max possible agreement beyond chance = 0.440

Kappa = 0.318

95% Confidence Intervals = -0.072 – 0.709