CHAPTER 4
RESULTS

4.1 *Salmonella* Isolation

Table 5 shows the proportion of *Salmonella* positive samples in each sample type from the age of the flock at one-day-old chicks and within three weeks before leaving for slaughter. At the age of one-day-old chicks, 65 out tested 71 flocks were positive (91.6%). Based on the sampling method, the 6 negative flocks were re-sampled within three weeks before the birds left for slaughter. The results show that 5 out of the 6 flocks were found positive to *Salmonella spp*. at this stage. In total, 98.6% of flocks were found *Salmonella* positive.

Table 5: Proportion of *Salmonella* positive samples in each sample type from broiler flocks

Age of flock at sampling	Sample type	Number of sampled flocks	Number of positive flocks (%)
One-day-old chicks	Chick box liner	71	65 (91.6)
Age at within 3 weeks before leaving for slaughter (re-sampling)	Boot swab	6	5 (83.3)
Total		71	70 (98.6)

Table 6 shows the detailed distribution of *Salmonella* spp. in broiler flocks. The prevalence of *Salmonella*-positive flocks was 91.6 %(95% CI: 83, 97) at one-day-old chicks and 98.6 %(95%CI: 92, 100) at within 3 weeks before leaving for slaughter, respectively.

Table 6: Distribution of prevalences of *Salmonella spp*. at broiler flocks level: at one-day -old chicks and within three weeks before leaving for slaughter

Age of flock	Number of flocks	Number of positive flocks	Proportion (95% CI)
One-day old-chicks	71	65	91.6% (83-97)
Within three weeks before leaving for slaughter	71	*(65+ 5)	98.6 % (92-100)

*The total number of positive flocks was the sum of positive flocks at age of one-day-old chicks (65) and the number of positive flocks after re-sampling within three weeks before leaving to slaughter (5).

4.2 Results of *Salmonella* serotyping

The distribution of *Salmonella* serotypes is shown in Table 7. The most frequent Serogroup was Group D with a proportion of 92.9%, followed by group C (6.5%) and group E (0.6%).

Table 8 describes that samples from the chick box liners were most frequently contaminated with *Salmonella* Serogroup D followed by Serogroup C, with proportions of 93.6% and 6.4%, respectively. From boot swab samples, the percentages of samples contaminated with *Salmonella* Serogroups C, D and E. were 9.1, 81.8 and 9.1, respectively.

Table 7: Distribution of *Salmonella* Serogroups at different ages of broiler flocks

Age of flock	Number of samples in each group					
	B	C	D	E	F- 67	Total
One-day-old chicks	-	10	147	-	-	157/213
Within 3 weeks before leaving for slaughter	-	1	9	1	-	11/18
Overall Total (%)	-	11 (6.5)	156 (92.9)	1 (0.6)	-	168 (100)

Table 8: Distribution of *Salmonella* Serogroups in broiler flocks by sample type

Serogroup	Samples (Number and % positive)	
	Chick box liners	Boot swabs
C	10 (6.4)	1 (9.1)
D	147 (93.6)	9 (81.8)
E	-	1 (9.1)
F-67	-	-
Total	157 (100)	11 (100)

The result from the table 9 shows that *S.*Enteritidis was the most frequent serovars with a proportion of 92.9%, followed by S. Mbandaka (4.2%), S. Weltevreden(0.6%) and *S.enterica* (2.4%). Chick box liners, collected from one-day-old chicks flock shows that *S.* Enteritidis was the most predominant serovars with the proportion 93.6% followed by *S.* Mbandaka(4.5%), *S.enterica* (1.9%) and the result is almost similar with the boot swab sample collected from flock at the age within 3 weeks before leaving for slaughter. The most frequent serovars was *S.* Enteritidis (81.8%) followed by *S.*Weltevreden(9.1%), *S.enterica* (9.1%) (Table 10)

Table 9: Distribution of *Salmonella* serotypes

Serovars	Number of isolates(%)
S.Enteritidis	156(92.9)
S.Mbandaka	7(4.2)
**S*.enterica	4(2.4)
S.Weltevreden	1(0.6)
Total	168(100)

*(O8,20: $z_4 z_{23}$:-)

Table 10: Distribution of *Salmonella* serotypes at different ages of broiler flocks and different sample type

Age of flock and Sample type	Serogroup	Serotypes	Number and % Positive
1. One-day-old chicks	C	*S*.Mbandaka	7(4.5)
Chick box liners	C	**S*.enterica	3(1.9)
	D	*S*.Enteritidis	147(93.6)
Total			157(100)
2. Within 3 weeks before	C	**S*.enterica	1(9.1)
leaving for slaughter	D	*S*.Enteritidis	9(81.8)
Boot Swab technique	E	*S*.Weltevreden	1(9.1)
Total			11(100)

*(O8,20: $z_4 z_{23}$:-)

4.3 Questionnaire results

The questionnaires concerning information of flock characteristics, holding characteristics and on management/productivity were collected by interviewing the farmers of all 71 study flocks in Chiang Mai and Lamphun provinces during sampling at the age of the flock of one-day-old chicks. Data were described by descriptive statistics such as percentages and range.

In the study area, the breeds Ross and Aber Acres were reared in the flocks, Ross at 43.7% and Aber Acres at 33.8% of flocks, respectively. The remaining flocks consisted of a combination of Ross and Aber Acres (22.5%). The number of birds raised per year in the holdings were differentiated for 3 sizes: ≤25,000 (16.4%), 25,000 - 50,000 (53.7%) and >50,000 (29.9%), respectively. The proportion of numbers of birds in the poultry houses and the number of broilers in the test flocks was the same, since the flock size depended on the size of the poultry house. Data show that in the majority of houses (and in test flocks) the number of birds was between 5,000 and 10,000 (64.8%), followed by more than 10,000 (23.9%) and ≤5,000 (11.3%), respectively. Concerning the number of crops (flock cycle) per year, three ranges were differentiated: less than 3 crops per year (0%), 3-5 crops per year (64.2%) and ≥6 crops per year (35.8%). Regarding the presence of beetles, flies or other insects inside the houses, only one poultry house was detected. However, farms were visited mainly on the first day of a new production cycle and the age of the houses had to be considered. Most of the poultry houses were constructed or reconstructed ≥5 years ago, (71.8%) 28.2% were less than 5 years old. The numbers and types of persons (producers, including farmers, workers and visitors) entering or routinely moving around the poultry houses during rearing revealed that in 52.1% of cases two persons or less took care of the birds without any visitors, followed by more than 2 persons with or without visitors (31%). In close to every fifth farm (16.9%), two persons or less took care of the birds, often with a visitor. Foreign persons, visitors, thus are a regular feature on about half of the farms. Pet animals such as dogs and cats were present in 59% of the farms. Concerning management: the water source was differentiated whether it was for drinking or for other uses on the farms. For drinking water, the sources were differentiated into tap water (37.7%), deep well

water (31.1%), surface water (26.2%) and more than one water source (4.9%). For other uses than drinking water in 13.1% was taken from taps, deep wells (37.7%) and surface water (49.2%). Feed in all cases and on all farms came from only one source. *Salmonella* vaccination was not used at all in the 71 flocks. In contrast, antimicrobial drugs seem to be used frequently; all of the 6 farms re-sampled 3 weeks before slaughter of birds had used antimicrobials during the last two weeks prior to sampling. This point to widespread use of antibiotics during the last 5 weeks of rearing. Finally, the hygiene practices in the farms were subjectively assessed: 60.7% of the farmers were assessed to have a good hygiene system in place, 39.3% a moderate system and none a poor system.

Table 11: General characteristics of flocks, houses and husbandry/management of broiler rearing in Chiangmai and Lamphun provinces (71 flocks, 61 Farms)

Characteristic	Level	n flocks	Percentage (%)
Age of broilers at sampling (in days)	Day 1	71	-
	Day 1 + Within 3 weeks before leaving for slaughter	6	-
Strain reared in flock	Ross	31	43.7
	Aber Acres	24	33.8
	Aber Acres and Ross	16	22.5
Number of the birds raised* per year in the holding	≤25000	11	16.4
	25000 - 50,000	36	53.7
	>50,000	20	29.9
Number of birds in the poultry house	≤5000	8	11.3
	5000 - 10,000	46	64.8
	>10,000	17	23.9
Number of crops (flock cycle) per year*	<3	0	0
	3-5	43	64.2
	≥6	24	35.8
Number of flocks in the holding at time of sampling	0	57	80.3
	1	10	14.1
	2	4	5.6
Number of broilers in flock tested	<5000	8	11.3
	5000 - 10,000	46	64.8
	>10000	17	23.9
Number of years since the construction or last reconstruction of poultry house	<5	20	28.2
	≥5	51	71.8
	yes	1	1.4

Characteristic	Level	n flocks	Percentage (%)
Visual detection of beetles/flies/other insects			
by interviewer during rearing**	no	68	98.6
Presence of other animal species	yes	36	59
(dog , cat)	no	25	41
Numbers and types of persons	≤ 2 producers or workers, no visitors	37	52.1
(producer, including farmer, workers and visitors) entering poultry house during rearing	≤ 2 producers or workers, with visitors	12	16.9
(at time before interview and collection of	>2 producers or workers ± visitors	22	31
sample)			
Source of feed	Unknown	71	100
Water source for drinking	Tap water	23	37.7
	Deep well	19	31.1
	Surface well	16	26.2
	More than one source	3	4.9
Water source for use in farm	Tap water	8	13.1
	Deep well	23	37.7
	Surface well	30	49.2
	More than one source	0	0
Salmonella vaccinations used during rearing	Yes	0	0
	No	71	100
Antimicrobials used during the last two weeks	Yes	***6	100
prior to sampling	No	0	0
Assessment of hygiene practices in farm	Poor	0	0
	Moderate	24	39.3
	Good	37	60.7

* 4 out of 71 poultry houses on the farms started rearing less than one year ago

** 2 of 71 flocks did not allow entrance into poultry house

***From re-sampling at within 3 weeks before leaving for slaughter

The anticipated analysis of risk factors for *Salmonella*-positive versus negative flocks could not be carried out as almost 100% of flocks were positive.