#### **Media preparation**

Media preparations were done by following the manufacturer's guidelines:

\* Buffered Peptone Water (BPW; Merck KGaA, Germany)

Preparation:

Suspend 25.5 g in 1 liter of demineralised water If desired, dispense into smaller bottles Autoclave in 15 minutes at 121 °C pH:  $7.0 \pm 0.2$  at 25 °C

\* Modified Semi-solid Rappaport Vissiliadis agar (MSRV; Merck KGaA, Germany)

Preparation:

Suspend 15.8 g in 500 ml demineralised water by heating in a boiling water bath or in a flowing steam until the medium is completely dissolved. (<u>Do</u> <u>not autoclave / do not overheat</u>!)

Dissolve the lyophilisate of 1vial MSRV Selective Supplement by adding 1 ml sterile distilled water and add the solution to the medium that cooled to 45-50 °C.

Mix gently and pour plates.

pH:  $5.2 \pm 0.2$  at 25 °C.

Drying of plates:

1. In a clean bench with air flow. Remove lids and let dry for 15-20 minutes

2. Without air flow 1 hour (lids removed) at room temperature.

Storage: The medium can be stored in the refrigerator at +2 - +8 °C for up to 2 weeks.

\* Muller-Kauffmann Tetrathionate-Novobiocin broth (MKTTn; Merck KGaA, Germany)

Preparation:

Suspend 89.5 g in 1000 ml demineralised water, heat briefly (5 min.) by boiling and cool rapidly. This solution has at refrigeration a shelf life of up to 4 weeks at 2-8°C. Sediment of calcium carbonate appears in the turbid broth at the bottom of the bottle/vessel.

Adjust the pH, if necessary, so that it is  $8.0 \pm 0.2$  at 25 °C.

Do not autoclave.

Prior to use add 20 ml iodine/potassium iodide solution to 1000 ml of basal medium, and then mix appropriately.

Dispense the medium aseptically and eventual precipitate into sterile test tubes as necessary.

The ready-to-use broth prepared and used the same day. The medium is turbid and green with white sediment (calcium carbonate).

\* Preparation of the iodine/potassium iodide solution:

Completely dissolve 5 g potassium iodide in 2 ml of water, then add 4 g iodine and dilute to 20 ml distilled water.

#### \* Brilliant Green Agar (BGA, Acumedia, USA)

Preparation:

Suspend 58 g of the medium in 1 liter of purified water.

Mix thoroughly.

Autoclave for 15 minutes at 121°C.

Using water bath to cooled to 50-60 °C.

Mix gently and pour plates.

#### \* Xylose-Lysine-Tergitol 4 (XLT4; Merck KGaA, Germany)

#### Preparation:

Suspend 59 g in 1 liter of demineralized water

Add 4.6 ml XLT4 Agar Supplement solution

Heat the medium in a boiling water-bath (not on a heating plate!).

Cool to approximately 50 °C and pour plates. *Do not overheat or autoclave!* pH:  $7.4 \pm 0.2$  at 25 °C.

#### \* Nutrient Agar (NA; Merck KGaA, Germany)

#### Preparation:

Suspend 20 g in 1 liter of demineralized water by heating in a boiling water bath or in a current of stream

Autoclave for 15 minutes at 121 °C.

Cool to approximately 50 °C and pour plates

pH:  $7.0 \pm 0.2$  at 25 °C.

#### \* Triple Sugar Iron Agar Slants (TSI; Merck KGaA, Germany)

#### Preparation:

Suspend 65 g in 1 liter of demineralized water by heating in a boiling water bath or in a current of stream

Dispense into test tubes

Autoclave for 15 minutes at 121°C

Allow solidifying to give agar slants and butt.

pH:  $7.4 \pm 0.2$  at 25 °C.

#### \* Urea broth (Urea; Sigma-Aldrich, USA)

#### Preparation:

Dissolve 38.7 g in 1 liter distilled water Filter sterilize, using 0.45 µm Millipore filter (must NOT be heated) Sterile aliquot into steriled test tubes

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#### Information in Hung Yen province and laboratory procedures

#### 2.1 Pig slaughterhouse and pork market information in Hung Yen province

	V				
No	District	Number of Communes	Number of Pork markets	Number of Slaughterhouses	Average No. of slaughtered pigs/day/all slaughterhouses
1	An Thi	21	30	25	29
2	Hung Yen city	12	32	30	38
3	Tien Lu	18	27	48	48
4	Van Lam	11	23	74	82
5	Kim Dong	19	38	60	90
6	Yen My	17	39	70	90
7	Phu Cu	14	20	65	93
8	Van Giang	11	29	25	95
9	Khoai Chau	25	43	67	167
10	My Hao	13	32	58	188
	Total	161	313	522	920

#### 2.2 Pig slaughter process in Hung Yen

Slaughter process was described as following and illustrated, including:

- Pigs are kept in pen/lairage, restrained by hook and fixed on stable shelf.
- Bleeding and collect blood in basin and move onto floor just nearby.
- Boiling water is taken in a bucket, and using the kettle to pour on carcass.
- Dehairing by knife with hands, then washing.
- Evisceration by one worker and one assist.
- Washing and then splitting the carcass into two half.
- Transportation of carcass directly to markets without chilling.





Reactions	Results	Reactions	Results
1. Glucose	Positive (+)	5. H <sub>2</sub> S	Positive (+)
2. Gas	Positive (+)	6. Urease	Negative (-)
3. Lactose	Negative (-)	7. LDC	Positive (+)
4. Sucrose	Negative (-)	8. VPR	Negative (-)
		9. Indole	Negative (-)

### 2.5 Standard Operation Procedure on Salmonella serotyping (Fries, 2005)



25 g 10 ml 10 ml 10 ml 225 ml Sample BPW 10-1 1 ml 1 ml+ 9 ml 10-2 1 ml+ 9 ml 🕿 1 ml+ 9 ml 9 ml BPW **BPW** BPW BPW 10-2 Remaining liquid 1 ml+ 9 ml 1 ml+ 9 ml 1 ml+ 9 ml BPW BPW BPW 10-3 Used for qualitative

2.6 Dilution procedures for pre-enrichment in 3 tubes-MPN method

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# Questionnaire on Pig source

Question	maire on Pig source
Questionn Interviewe Interviewe Pig from:	aire No: Time:h Date (dd/mm/yyyy):// er name:
1. What ki	ind of vehicle to transport pig to this slaughterhouse: Special truck $\square$ Motorbike $\square$ other: ( <i>specify</i> )
2. Was vel	hicle cleaned and disinfection before transporting pig? No
If	yes, how do you do:
3. Was vel	hicle specially designed to avoid dropping feces and urine during transportation? No
If	yes, how do you do:
4. At whic	ch time pig was transported?Early morning (1-6 am)Afternoon (1-6 pm)Night (6-12 pm)
5. How lo	ng did it take to transport pigs from farm to this slaughterhouse? Less than 1 h
D	istance?: (km)
6. Scale o	of pig production?
	Backyard (<5 pigs)
	Farm (11-50 pigs)
7. Pig pro	oduction system?
	Free raising  In traditional stable/indoor  Commercial style
8. Age of	pigs for selling?
	$\leq$ 3 months $\Box$ 3-4 months $\Box$ 5-6 months $\Box$ 7-12 months $\Box$ $\geq$ 12 months
A	verage live weight: (kg)
9. Can we	trace back transported pigs to the origin (to where)
If	yes, which level that we can trace back?
10. Pig dis	sease situation in 6 months recently? No
If	yes, which disease or problems?
11. Before	e preparing to buy and transportation, do you check the health status of pig? No
If	ves, how do vou do:

12. When transported to the slaughterhouse, do you apply for quarantine or transportation document from related authorities?

□ No □ Yes

If yes, to whom.....

13. When transported to the slaughterhouse, have any authorities inspect your pigs?

If yes, by whom.....

Thank you so much for answering the questions!

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Checklists

#### Pig Slaughterhouse Checklist

Checklisk ID: .... Time: .....h..... Date (dd/mm/yyyy): ...../..../...../

No	Observations	Yes	No	Note
Α	Lairage			5
1	Mixing of pigs from different origins in the same lairage			
2	Presence of abnormal signs or deaded pig.			
3	Presence of too thin pig in lairage			
4	Presence of feces in the lairage at slaughter time			
5	Slaughter area poses to lairage w/o hygienic measures			
6	Keep more than 1 pig/m2 in lairage			
7	Pigs entry lairage in separate way			
8	Wash live pig just before slaughtering			
В	Slaughterhouse and slaughtering			
1	Slaughterhouse in the same compartment with the house			
2	Using disinfection matrices in slauhgterhouse			
3	Slaughter on the floor			9
4	Specific place for bleeding			6
5	Specific place for scalding, dehairing			
6	Specific place for eviseration		4	
7	Specific place to split carcasses		A	
8	Eviseration by experience workers			
9	Carcass and internal organs are separated directly			
10	Workers wear apron	5		
11	Workers wear uniform			
12	Workers wear boots			
13	Separate wokers in each stage of slaughtering			
14	Using tank water for washing carcass and floor			
15	Washing floor after slaughtering each pig			
16	Washing kinfe, hook, hand after each pig			
17	Slaughter floor is usually washed after each pig			
18	Bucket, hand and knife is freely washed in water tank			
19	Use cloth for wiping carcass and hand/equipments			
20	Presence of stagnant washed water on slaughter areas			
21	People enter freely without Clean and Disinfection			nive
22	People can freely walk on every slaughter areas			
23	Carcasses are splitted into small part (<10kg)			
24	Carcasses/pork are stored in cool room.	C		
25	Carcasses are sent directly to the market.	0		
26	Transport carcasses outside w/o cover or cooling measures			

No	Observations	Yes	No	Note
С	Slaughtering control and waste management			
1	Record the number/origin of pigs slaughtered			
2	Presence of pest control measures	7 /		
3	Presence of meat inspectors/vet authority officers			
4	Waste water/liquid is put for biogas produce/treatment area	0		
5	Waste water/liquid drained to sewerage		75	
6	Waste water/liquid is put to the pool/river			
7	Solid waste is put into bin for treatment			
8	Solid waste is put into public garbage areas			5
9	Presence of bad smell in slaughterhouse environment			

# **Pork Shop Checklist**

Checklisk ID:	Time:h Date (dd/mm/yyyy):///
Checker's name	Pork shop ID

No	Observations	Yes	No	Note
1	Only pork are sold			
2	Pork is put in cool cabinet			
3	Pork is coverd by equipment			
4	Pork is closed or next to internal organs			5
	Table is higher than 60cm			
5	Table surface pork contaced is wood			
×	Table surface pork contaced is granit/enamlled tile			
	Table surface pork contaced is inox/steel			
	Table surface pork contaced is carton/paper	5		
)	Usually use insect control equipments while selling			r
_	Using wipe cloth during selling time			
2	Using wipe cloth for all pork, hand and equipments			
3	Using more than 1 knife			
	Using meat grinder			
5	Not use water while selling			
;	Using tap water in shop			
	Using bucket (mobile) water in shop			
;	Using cutting board			
)	Cutting on table surface directly			<b>NIV</b>
)	Shop is next to the sewerage			
ļ	Shop located in the specific area for pork selling			
2	Seller wears gloves	5		
3	Seller wears apron			

No	Observations	Yes	No	Note
24	Contact with vegetable and other meat source while selling			
25	Wipe hand on apron			
26	Wipe hand on cloth using for wipe pork/equipment			
27	Shop sells retail only	6		
28	Shop sells wholesale only			
29	Shop sells both retail and wholesale			
30	Contain pork in basket to to transport to the shop			
31	Carcass was transported to the shop with covering			5
32	Carcass was transported to the shop without covering			
33	Pork/carcass was shipped to the shop by motobike			
34	Pork/carcass was shipped to the shop by others			
35	Wash table at the end of selling time by water and detergent			
36	Clean table end of selling time by wiping cloth			No.
-37	Shops' offal is put in bin/place for treatment			720
38	Shops' offal is put freely to area around			30

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#### Group discussion and in-depth interview outlines and information

#### Focus group discussion outlines

#### \* Slaughter workers group

General information about participants

Practice of slaughter workers' activities:

- + Time, responsibilities, stages of slaughtering
- + Slaughter equipments need, reason of using them.

Practice sanitation and safety in the slaughter process

- + Measures to keep the carcass clean before, during and after slaughtering? Which is important?
- + Measures to ensure safety for you before, during and after slaughtering? Which is important?
- + How to clean cloths, clothes, boots, apron, knives, slaughter areas; and how often?
- + What activities (factors) during slaughtering can increase the contamination or decrease pork safety?

Control slaughter hygiene or safety and training.

- + Attend any training on food safety/practice in slaughtering; recently -when, by whom?
- + Health checks (when, what, how often)?

+ Apply and follow any regulation, rule or internal requirement when slaughtering? Quality and safety of meat (perception and knowledge)

- + What can affect to the pork quality and pork safety at slaughterhouse? Which diseases can induce microbiological contamination or reduce pork quality/safety?
- + Given potential factors that may lead contamination or low quality: rank by important.
- + What did you do to ensure pork safety and pork quality?

The presence of the disease in pigs (knowledge, perception/awareness)

+ Pig diseases can affect to the pork safety or/and quality? Frequently observed?

- + Know pig diseases can transmit to human (how, symptoms in human, prevent), know any human case(s) (when, where, how you know)
- + Slaughterhouse can relate to animal diseases transmission? How
- + Recently (6 months): illness suspect from pork/pig to your family members?

Desire to improve meat quality and food safety

+ What should we do and need and practical? Why?

#### \* Pork sellers group

General information about participants

Hygiene practices during pork selling

- + Criteria to select pork for selling and how?
- + What meat buyers care when buying meat from you?
- + What do you do with leftover meat?

Meat buying/selling practice

- + Measures to keep hygiene before, during and after selling? What are the most/less important and why?
- + How to clean equipments and frequency?
- + How to treat the waste (hairs, skin, and washed water)?

Control measures and training

- + Attend the training on food safety, what?
- + Health checks (recently, often)?
- + Inspection carried out during sell and transport?

Meat quality (perception/awareness)

- + What affect to pork quality/pork safety? List and the most/less important and why?
- + List and rank the potential risk factors can poses to microbiological contamination on pork?
- + Given potential factors related microbiological contamination on pork: Ranking by important

Pork borne diseases, zoonoses aspects (knowledge, awareness, perception)

+ Pig diseases can transmit to human, how, affect, symptom, how to prevent?, Know about human cases (when, where, how you know)

- + Recently (6 months): illness suspect from pork/pig to your family members?
- + Selling pork can relate to animal diseases transmission?

Desire to improve meat quality, food safety

+ What should be done to improve meat quality, food safety? What is important, why?

#### **In-depth interview outlines**

#### \* Public health staff and Veterinary staff

General information of interviewee, duty

Opinions about risk factors that may cause microbial contamination at slaughterhouse and market

- + Activities can cause cross contamination of carcass, workers' hand, cutting board at slaughterhouse, which is important, why?
- + Activities can cause cross contamination of pork, sellers' hand, cutting board at market, which is important, why?
- + Criteria for slaughterhouse and practice to ensure food safety? Which is important, why?
- + Criteria for pork shop and practice to ensure food safety? Which is important, why?

Awareness/perception of the risk and impact of unsafe pork

- + 1 year recently, any report of human case related to slaughtering, processing or consuming? (When, how, symptom)
- + Risk and affect of poor hygienic slaughterhouse or less safe pork to human health, animal and environment

Food safety, zoonoses management and collaboration

- + Slaughterhouse and market management related to food safety, environment sanitary? Which is important, why?
- + Activities/strategy of the office to protect consumer, animal, environment from foodborne or zoonotic diseases
- + Collaboration with other agencies/authorities related to food safety, zoonoses, environment sanitary (latest meeting, what issues), effectiveness of collaboration

#### \* People living around slaughterhouse

Any presence of slaughterhouses in this area/community, know detail? Perception and awareness about the slaughterhouse

- + Advantages of presence of slaughterhouse, which and why
- + Disadvantages of presence of slaughterhouse, which and why /risks?
- + Any complains (when, which issue, to whom)
- +Any reaction or change of situation, and what is the response/measure from slaughterhouse (better or worse)
- +Weakness of the slaughterhouse, why? How to minimize or what should be changed or need to improve of the slaughterhouse (food safety, hygiene, vet service, environment..)
- + Some criteria for future slaughterhouse? How can apply?

#### \* Pork consumers

General information about interviewee

Criteria when buying pork? How and why?

- + When, where often buy, why?
- + What do you feel secure when you buy pork rather than other?
- + What do you feel not secure to buy pork?

Knowledge or perception about risk of microbiological contamination at slaughterhouse and market, which is important

- + Criteria for slaughterhouse to ensure food safety?
- + Criteria for pork shop to ensure food safety?

Risk and affect of less safe pork, food born or zoonotic disease

- + What is "less safe pork"? And risk and affect to human health, animal and environment?
- + Know any human disease related pork (from where, how disease come, symptom)
- + How to prevent risk of illness from consuming pork/pork products
- + Recently (6 months): illness suspect from pork consuming to your family members?

#### General information about relevant groups

#### 6.1 General information about slaughter workers in discussed groups

Participants	Age	Gender	Education	Place	Year careers	Home- slaughterhouse	Working time
VG1	54	М	Secondary	VG	15	2 km	1.30 - 5.30 am
VG2	40	F	High school	VG	14	< 1 km	1.30 - 5.30 am
VG3	38	М	Secondary	VG	14	<1 km	1.30 - 5.30 am
VG4	36	М	Secondary	VG	12	2 km	1.30 - 5.30 am
VG5	19	М	High school	VG	1	< 1 km	1.30 - 5.30 am
VL1	54	М	Secondary	VL	20	< 1 km	2.00 – 6 am
VL2	41	М	Secondary	VL	3	< 1 km	2.00 – 6 am
VL3	28	М	College	VL	3	< 1 km	2.00 – 6 am
VL4	53	М	Secondary	VL	3	< 1 km	2.00 – 6 am
VL5	39	М	Secondary	VL	3	< 1 km	2.00 – 6 am

VL=Van Lam, VG= Van Giang, M= Male, F=Female

#### 6.2 General information of participants in pork sellers groups

Partici- pants	Age	Gender	Education	Slaughter/ Middle sell	Type of selling	Selling time	Pig/pork source	Years career
VL1	44	F	High school	Midd sell	Retail	Morning only	At market	5
VL2	54	F	High school	Midd sell	Retail	Morning only	At market	15
VL3	43	F	Secondary	Midd sell	Whs + retail	Morning only	At market	20
VL4	55	М	Secondary	Midd sell	Retail	Morning only	At market	25
VL5	48	М	High school	Slaughter	Retail	Morning only	Diameter 10 km	20
MH1	50	F	Secondary	Slaughter	Whs+ retail	4.30-11am	In private farm	10
MH2	49	F	Secondary	Slaughter	Whs+ retail	4-11am	In private farm	24
MH3	52	F	Secondary	Midd sell	Retail	5-11am, 4-6pm	At market	28
MH4	54	F	Secondary	Midd sell	Retail	5.30-11am	Slaughterhouse	5
MH5	52	F	Secondary	Slaughter	Whs+ retail	3-11am	In private farm	15
MH6	40	F	Secondary	Midd sell	Retail	4-11am	At market	20
VG1	43	F	Secondary	Slaughter	Whs+ retail	2_4h-10_11 am	In private farms	20
VG2	31	F	Secondary	Slaughter	Whs	4-9am	In private farms	9
VG3	55	F	Secondary	Midd sell	Retail	5.30-12am, 4.30- 7pm	At market	12
VG4	36	М	Secondary	Slaughter	Whs	4-8_9am	In private farms	16

Whs = Whole sale; F = Female; M = Male;

Inter- viewees	Age	Gender	Education	Occupation	Distance to SH (m)	For how long	Raise pig	Note
VL1	42	М	High school	Cake maker	80-100	42 years	No	raise pigs 2-3 yeas ago
VL2	51	М	High school	Smith	50	51 years	No	raise pigs 1 yeas ago
VL3	42	М	Secondary	Mechanical	100	42	No	raise pigs 2-3 yeas ago
VG1	57	М	Secondary	Agriculture	50	57 years	Yes	0 05
VG2	35	F	High school	Worker	80	5 years	No	5
VG3	46	F	Secondary	Small business	120	23 years	No	
MH1	30	F	High school	Small business	100	2 years	No	
MH2	53	М	Secondary	Worker	100	53 years	No	Raise pig 10 years ago
MH3	45	М	Secondary	Small business	50	45 years	No	

#### 6.3 General information about people living around in interview

#### 6.4 General information about pork consumer interviewees

Interviewee Age		Gender	Education	Occupation	Home to market (km)	Members in family	Amount (kg)/time
VL1	51	F	College	Primary teacher	1	5	0.5-1 kg
VL2	35	F	College	Accouter	0.5	5	0.5-1 kg
VL3	50	F	High school	Small restaurant	2	4	10-20 kg
VG1	69	М	College	Retied, pork processor	0.2	6	50 kg
VG2	51	М	High school	Business	0.5	3	0.3-0.4 kg
VG3	43	F	Secondary	Grocery owner	1.5	7	0.3-1 kg
MH1	38	F	Bachelor	Commune staff	0.5	3	0.5 kg
MH2	58	F	College	Staff, retied	0.7	6	0.5-1 kg
MH3	56	М	Bachelor	Bank staff	0.1	4	1-2 kg

#### 6.5 General information about public health staff in interview

Intervie wee	Age	Gender	Education	Year careers	Position	Duty
VG	55	F	College	30	Deputy of community health station	General manage, food safety at commune
МН	53	М	Doctor	25	Capital of the team on disease prevention and food safety of My Hao district	General manage, human resource, disease prevention, food safety task force
VL	46	F	Public health Bachelor	24	Member of the team on disease prevention and food safety	Food safety at district

#### 6.6 General information about veterinary staff in interview

Intervie	wee	Age	Gender	Education	Position	Year career
VG		30	М	DVM	Deputy of Vet district station	4
VL	R	37	М	DVM	Deputy of Vet district station	13
MH		36	М	DVM	Deputy of Vet district station	12/0
					DVM= Doctor of V	eterinary medicine

	Criteria	No 1	No 2	No 3	No 4	No 5	No 6	No 7	No 8	No 9	$Mean \pm SD$
1	Bright red, soft and sticky	9	10	10	10	10	10	8	9	10	9.6 ± 0.7
2	Fresh, good smell	9	10	9	10	9	10	10	9	10	9.6 ± 0.5
3	Cleanness	9	9	8	9	8	10	10	9	10	9.1 ± 0.8
4	Trust on seller	10	8	9	10	7	8	10	9	10	9 ± 1.1
5	Considered as safe meat	9	9	8	8	8	10	10	8	10	$8.9 \pm 0.9$
6	Good storage	10	9	7	10	9	10	5	7	_10	8.6 ± 1.8
7	Nutritional value	9	10	9	10	8	10	5	8	5	$8.2 \pm 2.0$
8	Pork inspection document	8	9	7	7	7	10	10	9	5	8 ± 1.7
9	Accessibility	8	9	7	7	7	5	5	9	10	7.4 ± 1.7
10	Price	7	8	7	7	6	6	5	8	5	$6.6 \pm 1.1$

#### 6.7 Pork selection criteria were ranked by consumers

SD= Standard deviation; No. = Participant number

#### 6.8 General information (education, gender and age) of participants and interviewees

		Focus g	roup	discussi	on		In-depth interview					
Information	Va	n Lam	.am Van		My Hao		Van Lam, Van Giang and My Hao					
	Seller	Slaughter worker	Seller	Slaughter worker	Seller	SH owner	Public health staff	Veterinary staff	People living around SH	Consume		
Education							V					
Primary school	-	-	-	-	-	14	/ -	-	-	-		
Secondary school	2	4	4	3	6	3	_	-	5	1		
High school	3	-	-	2	-	6-	-	-	4	2		
College	-	1	-	- 1	-		1		-	4		
University or higher	-	-	-	- h	~~		2	3	-	2		
Gender												
Male	2	5	1	4		3	1	3	6	3		
Female	3	-	3	1	6	-	2	-	3	6		
Age												
< 31	94	1	7-	1	-	17	<b>G</b> K	1	1	-		
31-40	-	1	2	3	1	2		2	1	1		
41-50	3	1	1		2	-	1	-	4	3		
51-60	2	2	1	1	3		2	-	3	4		
> 60	-	-	-	-	-	_	-	-	-	1		
Total	5	5	4	5	6	3	3	3	9	9		

# DECLARATION

I, the undersigned herewith, declare that this thesis is my original work and has not been presented for a degree in any university.

Signature: ..... Name: **Mr. Sinh Dang Xuan** Date of submission:

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# CURRICULUM VITAE

Name: Mr. Sinh Dang Xuan

Date of birth: 10<sup>th</sup> February, 1982

#### **Educational Background**

2001 - 2006: Hanoi Agricultural of University, Faculty of Veterinary and Medicine, Vietnam, as Degree: Doctor of Veterinary Medicine.

#### **Professional experiences**

- Sep, 2011- present: Researcher, Center for Public Health and Ecosystem Research (CENPHER), Hanoi School of Public Health.
- 2010-2011: Researcher, Research and Develop Product Centre: Cell culture and Virology Department, Pharmaceutical & Veterinary Material, JSC (Hanvet).
- 2006-2010: Researcher, Biochemistry Immunology and Pathology Department, National Institute of Veterinary Research, Vietnam.