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TITLE: Prevalence, Risk Factors, and Quantitative Risk Assessment (Introduction Level) of Caprine Arthritis-Encephalitis Virus in Meat Goat at Chainat Province, during October 2009 to October 2010

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THESIS

PREVALENCE, RISK FACTORS, AND QUANTITATIVE RISK ASSESSMENT (INTRODUCTION LEVEL) OF CAPRINE ARTHRITIS ENCEPHALITIS VIRUS IN MEAT GOAT AT CHAINAT PROVINCE, DURING OCTOBER 2009 TO OCTOBER 2010

PATTARIN OPASCHAITAT

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A cross sectional study was carried out, from October 2009 to October 2010, to estimate the prevalence, the risk factors, and quantitative risk assessment (introduction level) of caprine arthritis encephalitis virus infection (CAEV) in meat goats in Chainat province.

Questionnaires A (farmers) were collected from 61 herds, and 1,333 samples of sera were randomly selected and examined for CAEV antibodies using cELISA test kit. Analysis univariate logistic regression at $p<0.05$, then multivariate logistic regression at $p<0.05$ for the risk factors. Questionnaires B (experts) were collected from 9 expert opinions. Analysis the distribution model that run 5,000 times, 4 simulations, using a Monte Carlo approach implemented on a commercial software (@Risk version 5.5).

Result showed a true prevalence of 11.51% at herd level. Multivariate logistic regression showed significant risk factors associated with farm infection. Factors include herd size ($P<0.05$; OR: 22.016; 95% CI:1.55 – 311.92), long time raising of the farm ($P<0.05$; OR:1.776; 95%CI:1.02 – 3.08). The CAEV infected farms tend to have animals with history of mastitis ($P<0.05$). The result of the present study indicated that Chainat province has CAEV in the area and risk factors were about farm management. The probability of introduction of CAEV into goat farm decreased by test the animal before bringing new goats into farm 1.23 to 1.97 times. Therefore, appropriate screening tests and measurements of prevention are necessary to prevent the spreading of infection to other areas.

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Student's signature Thesis Advisor's signature

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Pattarin Opaschaitat
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LIST OF ABBREVATIONS

AGID	=	Agar Gel Immuno-Diffusion
°C	=	Degree Celsius
°F	=	Degree Fahrenheit
CAE	=	Caprine Arthritis Encephalitis
CAEV	=	Caprine Arthritis Encephalitis Virus
cm	=	Centimetre
cELISA	=	Competitive Enzyme Linked Immuno Sorbent Assay
CNS	=	Central Nervous System
COST	=	CO-operation in the field of Scientific and Technical Research
CPE	=	Cythopathic Effect
DNA	=	Deoxyribonucleic acid
EIA	=	Equine Infection Anemia
ELISA	=	Enzyme Linked Immuno Sorbent Assay
i.m.	=	Intramuscular
i.v.	=	Intravenous
IL-2	=	interleukin-2
IL-16	=	interleukin-16
ml	=	Milliletres
MVV	=	Maedi/Visna Virus
nm.	=	Nanometres
NSW	=	New South Wales
OPP	=	Ovine Progressive Pneumonia
PCR	=	Polymerase Chain Reaction
RIPA	=	RadioImmunoPrecipitation Assay
RNA	=	Ribonucleic acid
RT-PCR	=	Reverse Transcriptase Polymerase Chain Reaction
s.c.	=	Subcutaneous
SRLV	=	Small Ruminant Lentivirus
USA	=	United States of America

PREVALENCE, RISK FACTORS, AND QUANTITATIVE RISK ASSESSMENT (INTRODUCTION LEVEL) OF CAPRINE ARTHRITIS ENCEPHALITIS VIRUS IN MEAT GOAT AT CHAINAT PROVINCE, DURING OCTOBER 2009 TO OCTOBER 2010

INTRODUCTION

Most goat farms in Thailand are located in the central, western, and southern parts of Thailand. Chainat province is one of the central provinces that has many goat farms and is a major source of meat goats for customers in the south of Thailand, which has a high demand for halal food especially after the Ramadan festival (Muslim religious ceremony). Goat farms require low investments and earn a high income due to the high yield and low cost management. Goats require little feed to be provided, they always give birth to twins who are able to be weaned much faster than other stock animals. With its high demand from customers, the amount of meat goats is presently not enough to supply the market. Therefore, the total number of goat farms is increasing as a result of the market mechanism. Data from department of livestock and development (DLD) showed that the number of meat goats from 2004 to 2009 were 250,076, 338,355, 324,150, 444,774, 374,029, and 383,796 animals respectively (DLD, 2005, 2006, 2007, 2008, 2009). More farmers are tuning to goats however they lack knowledge regarding goat farm management issues, such as health status, infectious diseases, and parasites. Many goat farmers lack information on important disease such as brucellosis, foot and mouth disease, caprine arthritis encephalitis, and endoparasite. This should be corrected to aid farmers in raising healthy goats, thus allowing them to obtain greater benefits from their investment and help to improve the agriculture industry. If goat farmers are more knowledge about the health issues of their goats, they will be able to earn more income by producing more healthy goats, more kids, and more meat. It suggest: a more successful farm would be able to hire more local laborers, in doing so help with unemployment and the local economy.

This thesis focuses on caprine arthritis encephalitis infection in goats as currently there is a lack of information regarding this disease. Knowing the risk factors of CAE infection in Thailand will improve the protection and control of the disease.

OBJECTIVES

1. To estimate the prevalence and risk factors of caprine arthritis encephalitis disease in meat goats in Chainat province, during October 2009 to October 2010.

2. Quantitative risk assessment of CAE at introduction level of goats from unknown origin and health status, and onto established goat farms.

LITERATURE REVIEW

Epidemiology in global aspect and Thailand

Caprine arthritis encephalitis (CAE) occur worldwide especially in intensive goat dairying industries countries, with prevalence exceeding of 65% in these all (Knowles, D. P. *et al.*, 1992; Smith, M. C. and D. M. Sherman, 2009b). For example the United Kingdom has a prevalence of 10.3% (Dawson, M. and J. W. Wilesmith, 1985), Switzerland at 42% (Krieg, A. and E. Peterhans, 1990), United States of America (USA) at 73% (Cutlip, R. C. *et al.*, 1992), Norway at 97% (Nord, K. *et al.*, 1998c), Jordan at 23.2% (Al-Qudah, K. *et al.*, 2006), Italy at 81.5% (Gufler, H. *et al.*, 2008). In agricultural countries that actively import goats, prevalence is usually less than 10% (Smith, M. C. and D. M. Sherman, 2009b) as seen in such countries. Turkey with a prevalence of 1.9% (Burgu, I. *et al.*, 1994), Somalia at 6% (Ghanem, Y. M. *et al.*, 2009), Paraiba state of Brazil at 8.2% (Bandeira, D. A. *et al.*, 2009), however, Rio de Janeiro state of Brazil is an exception at 14.1% (Lilenbaum, W. *et al.*, 2007). Algeria imported dairy goats from high prevalence country, so CAE positive goats have been found, whereas before importation there was no report of CAE infection (Achour, H. A. *et al.*, 1994). In Spain, goats have been imported from other European countries with a high prevalence of the disease, mainly from France, and they may have introduced the disease into the indigenous goat population. A serological survey of caprine arthritis encephalitis virus (CAEV) antibodies was carried out, and 12.1 % prevalence was found (Contreras, A. *et al.*, 1998). In Yucatan, Mexico all of the seropositive goats (3.6%) from 3 herds were imported from the neighboring Mexican state of Campeche or the USA (Torres-Acosta, J. F. J. *et al.*, 2003). In Brazil (Bandeira, D. A. *et al.*, 2009) bucks that originated in other states had a significantly higher frequency of infection (76.5%) than those from Paraiba State (9.3%). The importation of goats was an important factor in the spreading of the disease in the areas. Japan has report cases of CAE in the country although they have not reported the level of prevalence (Konishi et al., 2004).

If herds have not implemented appropriate control measures, the prevalence of CAEV infection within most herds increases, such as in New South Wales (NSW) during 1986-1988 prevalence was at 56.8%, whereas at the end of the study in 1995, there was 59.7% prevalence (Greenwood, P. L. *et al.*, 1995). The imposition of strict quarantines, mandatory testing and slaughtering of CAEV positive animals imported from endemic area are suggested to prevent the introduction of the disease into the country. Nigeria for example in has successfully reduced the prevalence of CAE by slaughtering all positive animals (Baba et al., 2000).

Since 1998, laboratories from 16 European countries established collaborations within the framework of a COST (CO-operation in the field of Scientific and Technical Research) an action sponsored by the European Union in order to better organize their research programs on small ruminant lentiviruses (SRLV = maedi-visna in sheep and CAEV in goats) and to coordinate efforts to combat these 2 diseases (Peterhans, E. *et al.*, 2004).

The first occurred of CAE in Thailand was during the period of 1984 to 1985 at Nong Kwang Livestock Breeding Station, Ratchaburi province, with goats imported from Australia. Their clinical signs were paresis and ataxia leading to chronic wasting, lameness, debilitate, paralysis, recumbency and death. No gross lesions at necropsy but retrovirus particles found in the spinal cord by electromicroscopy and serology suggested CAE like virus infection (Tantaswasdi, U. *et al.*, 1985). The next report in the survey of CAE by Viturakul (1990) at the Veterinary Research and Development Center (upper northern region) showed one positive serum sample in 1987 by immunodiffusion test but no positive sample in 1988. The seropositive goat may be imported for breeding and dairy, which is a more intensive management than grazing of domestic meat goats. In 2002, a study of CAEV antibodies in goats on a farm in Ratchaburi province, this farm raised mixed breeds of goats on the farm such as (Viturakul, C. *et al.*, 1990)Angro-nubian, Boar, Toggenburg and mixed breed of Angro-nubian, Boar, and Saanen 182 goats in total, 119 serum samples tested by CAEV (AGID Test P28) test kit, showed 21% positive (25/119) (most of seropositive were 10 months to 3 years, minimum was 9 months, maximum was 9 years old). They were continuously recorded for clinical signs, but 1 goat was culled. This study found that 66.7% showed swelling of carpal joint, 29.17% cachexia, 20.83% posterior ataxia and stiffness, 4.17% swelling of hock joint, and 16.67% with no clinical sign (Chantakot, S. and M. Watthanakul, 2005).(Chantakot, S. and M. Watthanakul, 2005) In 2009, Ratanapob et al conducted a study in the central and western part of Thailand that found herds had 47% seroprevalence while individual had 12.4%, dairy goats had higher seroprevalence than meat goats (20.63%, 9.46%, $p < 0.001$)(Ratanapob, N. *et al.*, 2009) the animals were tested by enzyme linked immunosorbent assay (ELISA) test kit. The difference between seroprevalence in dairy and meat goats may have been due to differences in management or species susceptibility between the types of goats. Breeder goats had higher seroprevalence than yearly goats and kids (15.94%, 7.69%, $p < 0.001$). Female goats have higher seroprevalence than male goats (13.21%, 6.67%, $p = 0.054$) (Ratanapob, N. *et al.*, 2009). Finally reported in 2010 at Prachuapkhirikhan province Chanlad and Prasitphon (2010), tested for CAEV infection by competitive ELISA (cELISA) test kit, showed individual prevalence was 6.77% (34/502), herd prevalence was 37.25% (19/51). The individual risk factor of CAE was herd size ($p < 0.05$; OR: 2.9; CI, 1.14 - 5.03), herd level factors were farm size, being raised with other animals, bringing new goats into an established herd, contact with other goat herds/farms. Herd level factors had no effect or relationship to the prevalence of CAEV.

Natural history of disease

Caprine arthritis encephalitis (CAE) is a chronic disease in both dairy and meat goats, of all ages, infection is caused by the Lentivirus of the family *Retroviridae*, it effects multi-organ systems, once the animal has become infected they become a carrier and the infection is for life. It was first recognized in the early 1970s, the initial name of the disease, viral leukoencephalomyelitis of goats, was gradually replaced by the currently applied, caprine arthritis encephalitis, CAEV is a significant and costly disease in goats. Many countries with high infection rate, suffer high economic, and animal welfare impact (Narayan, O. and L. C. Cork, 1990;

Knowles, D. P. *et al.*, 1992; Murphy, F. A. *et al.*, 1999; Smith, M. C. and D. M. Sherman, 2009b). Other than goats and sheep, wild ruminant such as mouflon, ibex, and chamois, have also been reported as infected (CSFPH *et al.*, 2007).

Classification

Family *Retroviridae* consists of many important veterinary viruses; those are the pathogens of many diseases in different species including cattle, feline, poultry, and primates. The prefix *retro* (reverse, backward) is use to describe the virus' nature of reverse-transcription (RNA dependent DNA polymerase). Retroviruses all share commonalities in their antigens, however they vary in their complexity in differences, Retroviridae viruses are categorized into 7 genuses: *Alpharetrovirus, Betaretrovirus, Gammaretrovirus, Deltaretrovirus*, *Epsilonretrovirus, Lentivirus*, and *Spumavirus*. Caprine arthritis encephalitis virus (CAEV) is a member of genus *Lentivirus*, a single-stranded RNA virus. Protein structure within lentivirus (*gag* and *pol* gene products) was difference in each and complex of cross-reactivity (Narayan, O. and L. C. Cork, 1990; Knowles, D. P. *et al.*, 1992; Murphy, F. A. *et al.*, 1999) for instance CAEV has relatively genetics to equine infection anemia (EIA), ovine progressive pneumonia (OPP), also immune-deficiency in human and primates. The most closely relation of CAEV is North American isolates of maedi/visna virus (MVV) by co-antigen characterization, and their significant same bio-structure, but distinct viruses with strong host species predilection for goats and sheep respectively, at the same time there is evidence for cross species transmission, moreover they are grouped and named small ruminant lentivirus (SRLV) (Reilly, L. K. *et al.*, 2002; Smith, M. C. and D. M. Sherman, 2009b).

This corresponds with the SRLV group C in Norway that found in mixed goats and sheep herd. In addition SRLV group A and MVV liked or A1 subtype can found in sheep from cross species infection, explored CAEV group C can infect to sheep via infected goat (Shah, C. *et al.*, 2004). Sheep can infect both group A and C (Gjerset, B. *et al.*, 2007). CAEV in the goat breed Roccaverano was grouped in genotype E (Reina, R. *et al.*, 2009).

Subgroup

Many reports use the words subgroup or subtype or genotype to classify CAEV into groups by molecular characterization. For example, the subgroup SRLV B1, which is common worldwide (Gufler, H. *et al.*, 2008; Ramírez, H. *et al.*, 2010), or the prototypic strain CAEV-CO, normally found in goat but can also be found in sheep, if there is direct contact between mature animal (Pisoni, G. *et al.*, 2005).

The molecular character of CAEV B1 strain in Switzerland does not differ when comparing the B1 strains in France, Brazil, or the USA. Studies show this indicates that CAEV is spreading through international trade and is confirmation that goats can be infect by CAEV by direct contact with infected sheep (Shah, C. *et al.*, 2004).

Table 1 Classified retrovirus in genus and diseases in several species.

Genus	Virus
Alpharetrovirus	Avian leukosis viruses, avian carcinoma viruses, avian sarcoma viruses, avian myeloblastosis viruses, Rous sarcoma virus, duck spleen necrosis virus
Betaretrovirus	Mouse mammary tumor virus, ovine pulmonary adenomatosis virus (Jaagsiekte), Mason-Pfizer monkey virus, simian type D virus 1, langur type D virus, squirrel monkey type D virus
Gammaretrovirus	Feline leukemia virus, feline sarcoma viruses, porcine type C virus, many murine leukemia viruses, many murine sarcoma viruses, gibbon ape leukemia virus, woolly monkey sarcoma virus, guinea pig type C virus, viper type C virus (and avian reticuloendotheliosis viruses)
Deltaretrovirus	Bovine leukemia virus, human T lymphotropic viruses 1 and 2, simian T lymphotropic viruses
Epsilonretrovirus	Walleye dermal sarcoma virus, walleye epidermal hyperplasia viruses 1 and 2
Lentivirus	Human immunodeficiency viruses 1 and 2, simian immunodeficiency viruses (African green monkey, sooty mangabey, stump-tailed macaque, pig-tailed macaque, rhesus macaque, chimpanzee, and mandrill viruses), maedi/visna virus, caprine arthritis-encephalitis virus, feline immunodeficiency virus, equine infectious anemia virus, bovine immunodeficiency virus
Spumavirus	Bovine, feline, simian, and human foamy viruses (which are a problem when they contaminate cultured cells but are not known to cause disease)

Source: Murphy, F. A. *et al.* (1999)

Bio-chemical properties

Virus cultures can be derived from goat synovial membranes cells. Viral growth cycle takes 15 to 20 days. Mature viruses can bud from cell membranes, but most will bud from endoplasmic reticulum in cytoplasm of vesicles. Viral replication in cell cultures occur when merge to form a giant cell. Cytopathic effect can be observed (Narayan and Cork, 1990).

CAEV can be inactivated by chemical reagents, because the viral envelope is made of lipid and proteins which are fragile. A lipid solution, detergent, soap, periodate phenolic, formaldehyde quaternary ammonium compounds, formalin, hypochlorite, or an acidic solution with a pH < 4.2 act as disinfectant for the virus.

Heating the virus by 56°C (133°F) for 60 minutes can deteriorate agent. Popular reagents of choice are phenolic or quaternary ammonium compounds (Narayan, O. and L. C. Cork, 1990; CSFPH *et al.*, 2007; Smith, M. C. and D. M. Sherman, 2009b).

Periods

Incubation

Most infected goats will not show any clinical signs or test positively for 2 to 9 years suggesting a long incubation period. In Greece, none of the infected animals exhibited any clinical signs of the disease (Karanikolaou et al., 2005), Switzerland with a prevalence of 42% only 20-30% of the infected animals developed carpal joint inflammation or mastitis (Krieg and Peterhans, 1990). In northern Italy seroprevalence was 81.5% but the clinical incidence was 2.5% (Gufler et al., 2008). CAEV-infected does tend to have a subclinical bacterial infection of the udder ($P < 0.05$) (Ryan et al., 1993).

Seroconversion

Goats usually seroconvert in 2 to 8 weeks with a mean of 3 weeks to months, shorter in high prevalence herds than low prevalence herds, but can have a long clinical latency (years) (Reilly, L. K. *et al.*, 2002; Smith, M. C. and D. M. Sherman, 2009a). Even with low antibody titres goat may temporally seronegative however not all goats will (Cebra, C. and M. Cebra, 2002; Reilly, L. K. *et al.*, 2002; Peterhans, E. *et al.*, 2004). Some seroconversion in goats less than 1 year of age may result from neonatal infections with delayed humoral response. However, it is highly unlikely that the majority of adult seroconversion is due to this, as in naturally and experimentally infected kids, an antibody response is usually detectable between 3 and 10 weeks following exposure, through delays of up to 8 months and possibly longer for seroconversion have been reported (Smith, M. C. and D. M. Sherman, 2009b). Many goats seroconvert after a period of stress or at parturition (Matthews, J., 2009a).

Infectious stage

Infection occurs by transmission of fluids that contain infected macrophages from an infected animal to an uninfected animal (Reilly, L. K. *et al.*, 2002). CAEV can be transmitted both horizontally and vertically.

Horizontal transmission may occur, but only after prolonged exposure (Belknap, E. B., 2002). The virus is very labile in the environment and transmission via pasture or building, etc., will not occur (Matthews, J., 2009a).

1. Contamination in dairy machine and milk bulk tank is a risk factor for CAEV infection. Because at each time of milking, there have been many goats that have used the same piece of machinery. If a virus has contaminated a piece of machinery, a risk of spreading the virus to other is present. Milk tank that are contaminated, will contaminate the milk, thus when brought it to feed kids, they will be infected.

2. Aerosol transmission and direct contact happens at all ages that are in close contact (East, N. E. *et al.*, 1987) or separated by several metres, within and between herds especially when indoors and with intensive management. Kids are high risk for transmission as they are always close together either in their pens or playing together while out grazing (Narayan and Cork, 1990). Virus-infected monocytes or macrophages shed in body fluids such as saliva, urogenital secretions, feces, and/or respiratory tract secretions. The amount of CAE-infected cells found in respiratory, oral, lacrimal, and urogenital secretions is low so that prolonged contact is necessary for horizontal transmission to occur (Matthews, J., 2009a). 76.9% of seronegative goats 24 months old will be seropositive, if mixed herd with infected goats (Leitner, G. *et al.*, 2010), uninfected does commonly seroconvert when milked with infected does, presumably as a result of transfer of virus during milking process (Reilly, L. K. *et al.*, 2002).

3. Cross-species infection between goats and sheep can occurred, but it is not yet clear if cross-species infections occur with other farm animals. In Poland CAEV from goats that nearby MVV in sheep, this showed cross-species infection from sheep to goats (Kuzmak et al., 2007) or from goats to sheep (Gjerset et al., 2009). Mouflon-domestic sheep sensitively infected CAEV (Guiguen et al., 2000) and in naturally infection, co-infection of SRLV group A (MVV group) with group B (CAEV group) can occurred (Pisoni et al., 2007). In Australia and New Zealand inoculation experiments in sheep was conducted and arthritis was found, this differs from field research which finds no infected sheep being reported (Murphy et al., 1999).

4. The management of milking herd, intensive feeding, and poor farm management such as dirty water, low quality feed, contaminated equipment, and malfunction of dairy machine are also involved to the CAEV infections (Greenwood, P. L. *et al.*, 1995).

5. Humans can spread disease by clothes, boots, and equipments that joined between infected and non-infected herds.

6. Iatrogenic transmission via unsterilized tattooing and hypodermic needles, by dehorning equipment, are possible (Reilly et al., 2002). Transmission occurs by blood transfer from an infected to a non-infected goat (Matthews, 2009a).

Vertical transmission has also been documented and consists of;

7. Intra-uterus infection is not clear, approximately 10% of fetus that parturition test positive for CAEV. The placenta, which is contaminated with infected does' blood can cause infection however this is not the main route of transmission (Narayan, O. and L. C. Cork, 1990). Some textbooks state that transplacental infection does not occur or does so rarely (Matthews, J., 2009a). The probability of transplacental infection or in parturition process is only 3.8% (Lara, M. C. C. S. H. *et al.*, 2005). Some studies showed that the oocytes were sterile even the cumulus cells that surrounded oocytes had proviral DNA of CAEV (Ali Al Ahmad, M. Z. *et al.*, 2005). Proviral DNA of CAEV has been found in the genital tract ascending from

uterus to oviduct and is possibly a method of vertical transmission of CAEV from does to embryo or fetus (Fieni et al., 2003).

8. Even if mRNA and proviral DNA of CAEV were detected in the male genital tract transmission through spermatozoa in semen can occur but the probability is very low (Travassos, C. E. *et al.*, 1999; Ali Al Ahmad, M. Z. *et al.*, 2008a). Cell-free seminal fluid (CFSF) and/or non-spermatozoa cell fractions such as monocytes, macrophages, epithelial cells, and CAEV provirus without syncytia showed none or low level of proliferation of virus (Travassos, C. E. *et al.*, 1999).

9. Contaminated colostrums and milk ingestion were the most common and efficient route for infection (Belknap, E. B., 2002), the presence of antiviral antibodies in colostrums is not protective (Reilly, L. K. *et al.*, 2002). An effect on newborns infected by CAEV is leukoencephalitis which can be found after 60 days of infection. (Narayan and Cork, 1990). 61% of kids that received untreated colostrums were seropositive at 9-11 months old (Leitner, G. *et al.*, 2010). Because of the physiology of the ruminant neonatal intestine, the adsorption of infected maternal cells is possible, these infected cells are taken up intact from the gut and enter the reticuloendothelial system to shaped the evolution of particular lentiviruses that represent a valid model of lactogenic lentivirus transmission (Smith, M. C. and D. M. Sherman, 2009a; Pisoni, G. *et al.*, 2010). Dairy goat management such as mixed use milk bottle as well as contact to kids in nursery (Narayan, O. and L. C. Cork, 1990). Kids will subsequently test negative until they seroconvert and produce their own antibodies several months or even years later (Matthews, J., 2009a).

Epidemiology study of CAEV infection reviewed dogs and cats did not show correlation with risk factor of CAEV infection (East, N. E. *et al.*, 1993; Blacklaws, B. A. *et al.*, 2004; Peterhans, E. *et al.*, 2004). No evidence supports transmission by an insect vector (Reilly, L. K. *et al.*, 2002).

Clinical signs

Most infected goats did not show clinical signs or signs develop over a long period of time. Animals that showed clinical signs can be divided into 2 ranges of age (Murphy, F. A. *et al.*, 1999; Machen, M. R. *et al.*, 2002; Reilly, L. K. *et al.*, 2002; Matthews, J., 2009a; Smith, M. C. and D. M. Sherman, 2009a) including:

1. 1 to 6 months of age, first common clinical signs shown were encephalomyelitis, paresis at hind limbs or ataxia or uni- or both hindlimbs, as the disease progress, kids may become blind, develop a head tilt, facial paralysis, opisthotonos, and on rare occasions circling. The clinical course of disease can last from 1 to 2 weeks. Within 2 to 4 weeks, paresis will progress to tetraplegia and finally become paralysis. Encephalomyelitis infected goats tend to have rough hair and suffer from muscle atrophy. Pneumonia may occurred alone or compliment a central nervous system (CNS) disease. Arthritis occasionally occurs in kids as young as 6 months.

2. From approximately than 6 months to 12 months or older arthritis, synovitis, and mastitis, encephalomyelitis or pneumonia liked symptoms in kids, rapidly dyspnea and paralysis.

Clinical signs of CAE involved several organ systems, however, most infected animals remain asymptomatic. The 4 main clinical syndromes include:

1. Arthritis and lameness; the most common manifestation of CAEV infection is chronic polyarthritis. Clinical arthritis is estimated to occur in less than 25% of seropositive animals but it may be more prevalence in some herds (Reilly, L. K. *et al.*, 2002). In the early stage, joint swelling may wax and wane, appear and feel normal, no fever, lameness is minimal, and normal appetite. Lameness is variable from slight stillness to extreme pain on standing. Some animals experience a sudden onset of lameness. The time course is varies for each individual, with some animal deteriorating over a few years and others remaining stable for several years. The severity of pain varies depending on the location of infection. Debilitated, hooves will continue to grow, results in abnormal posture, recumbence, which may cause ulcers, abscess, and osteomyelitis. Severe and prolong arthritis can cumulate in mineralization, ligament and tendons rupture, resulting in the goats not being able to stand. Onset of arthritis is not clear but can develop gradually from months or years, in some cases arthritis can occurred immediately and as opposed to progressively. Joint, bursae, and tendon sheaths are target organs. Commonly found at carpal joint or knee of forelimbs, called informally “big knee disease”, swelling and pain joint. Painful arthritis is usually accompanied by gradual weight loss and a roughening of coat hair. This sign vary among within herd that approximately 9 to 38% seropositive goats. In experimentally infected newborns, infected by oral transmission, showed swelling of carpal joint at 6 months of age in 25 to 40% of the goats (Knowles, D. P. *et al.*, 1992). Swellings may be up to 10 cm in diameter, and is fluctuant, and cool, but does not cause pain touched. Fluid can be aspirated from these swellings for diagnostic purposes, but drainage only leads to refilling. This pathogenesis will also occur at the hock, stifle, shoulder, fetlock, tarsal, vertebral, and finally coxofemoral joints. These conditions may develop or stay periodic cycles of swelling, possible pain, and spontaneous improvement (Narayan, O. and L. C. Cork, 1990; Zink, M. C. *et al.*, 1990; Knowles, D. P. *et al.*, 1992; Murphy, F. A. *et al.*, 1999; Reilly, L. K. *et al.*, 2002; Smith, M. C. and D. M. Sherman, 2009a).

2. Encephalomyelitis or leukoencephalomyelitis associated with paralysis ascending the upper body, severe paresis, tremors, rough hair, paralysis of the head, neck tilt, and circling. However, afebrile, alertness, appetite, and sight all normal.

3. Pneumonia can be found in high prevalence goat herds, typically in adult goats, onset and progressive are unclear. Interstitial pneumonia early sign usually include a dry cough, which later progresses to chronic dyspnea, weight loss and abnormal lung sound. It is usually chronic and closely resembles those of OPP.

4. Mastitis (hard udder, indurative mastitis) gradual fibrosis and induration of the udder. In adult goats it is more difficult to detect, because only a histology examination will detect this sign, it cannot be found by physical examination (Narayan, O. and L. C. Cork, 1990). However the characteristics of mastitis by CAEV

are hyper-proliferation of the lymph system, firm swelling. Some cases mammary gland swelled immediately, while treatable with supportive treatments the change in size and density is irreversible. Experimental study inoculation non-pregnant goats, demonstrated goat susceptibility to mastitis by CAEV infection (Knowles, D. P. *et al.*, 1992). Hypogalactia, agalactia notes at parturition in young does (Smith, M. C. and D. M. Sherman, 2009a).

Only 20 to 30% of infected goats showed inflammation at carpal joint or mastitis (Krieg, A. and E. Peterhans, 1990). Chronic progressive weight loss is often seen, either in conjunction with other clinical signs or on its own (Matthews, J., 2009a).

Carrier stage

Infection is lifelong and persistent, all infected goats will be carriers, shedding through colostrums and aerosol secretion (Narayan, O. and L. C. Cork, 1990). Granulosa cells (Lamara, A. *et al.*, 2001) and bone marrow stromal cells (Grossi, P. *et al.*, 2005) were cultivated during infection but did not show clinical signs. The virus can thus be unwittingly spread throughout the flock or herd, particularly to the young stock, without the owners being aware of a carrier being present (Matthews, J., 2009a).

Risk factors

Farm management involved

1. Rearing with sheep: (Ghanem, Y. M. *et al.*, 2009) SRLV seropositive sheep associated with seroconversion in SRLV seronegative goat herd (odds ratio=26.9) support to the cross species transmission between sheep and goat (Brulisauer, F. *et al.*, 2005).

2. Herd size: (Gufler, H. *et al.*, 2008) more number of goats in herd will raise the probability of finding a seropositive on that farm, because creates high density of animal and has a tendency to have poor biosecurity and sanitary management (Al-Qudah, K. *et al.*, 2006) so, it more likely to transmit the disease. For example large herd (>100 goats) compared with medium (51-100 goats) and small herd (10-50 goats), which 72% of farm were large herd size (Al-Qudah, K. *et al.*, 2006), cut off at median 42 goats to divided into 2 groups of herd size consists of >40 goats compared with 20 to 40 goats and <20 goats (Ghanem, Y. M. *et al.*, 2009), corresponded to one study in Thailand (Chanlad, S. and S. Prasitphon, 2010) >45 goats compared with ≤45 goats. However, herd size was not a risk factor in the study of Cutlip, R. C. (1992).

3. Introducing new animals (Al-Qudah, K. *et al.*, 2006): CAE is an infectious disease so new animals can introduce the disease to the herd. As most CAEV infected animals do not show any clinical signs and it has long incubation period, new animals may be carriers. They can spread the virus to the other animals in the herd before they can be detected.

4. Mixing with other goat herds: (Al-Qudah, K. *et al.*, 2006) results in directed contact with droplet from respiratory system and breeding. Moreover it causes in-directed contact with the virus contaminated in environment such as soil, pasture or water source.

5. Keeping goats indoor: some studies found that in some countries where goats were kept indoor during harsh seasons, seroprevalence in kids born indoor was higher than kids born outdoor. It may be a result of kids born indoor being in more close contact with their mothers (Gufler, H. *et al.*, 2007).

6. Pooling colostrums: using pooled colostrums from several does is an important risk factor of CAEV infection in the herd. Nursing from other does and using pooled milk are risk factors of CAEV infection while gender is not (Dawson, M. and J. W. Wilesmith, 1985; Gufler, H. *et al.*, 2007; Matthews, J., 2009a).

7. Raising kids with pasteurized milk: kids that were raised with non pasteurized milk have more tendency to be seropositive than kids that raised with pasteurized milk (Rowe, J. D. *et al.*, 1991; Rowe, J. D. *et al.*, 1992a).

8. Effect of milking: milking has an effect on seroconversion, Rowe, J. D. *et al*. (1992b) found that milking significantly affect CAEV infection in yearling goat and goat more than one year old age.

Animals factor

9. Age: older goats have a greater tendency to be seroconvertion than young goat (Nord, K. *et al.*, 1998b; Ghanem, Y. M. *et al.*, 2009). 2,3,4, and 5 years or more of age have higher probability to seropositive than 1 year old by 1.7, 2.6, 4.5, and 5.7 times (Rowe, J. D. *et al.*, 1991). More than 1 year old goats tend to seroconvert. Goats that are 3 and ≥ 4 years old have higher probability to seroconvert than goats which 2 years old by 1.7 and 3.2 times, respectively (Rowe, J. D. *et al.*, 1992b). While Cutlip et al. (1992) showed increasing prevalence in goats 3 years old (Cutlip, R. C. *et al.*, 1992).

10. Breed: some studies did not found relation between disease status (Rowe, J. D. *et al.*, 1991). However, some found different prevalence among breeds of goats. For example, Angora and Pygmy goats had lower prevalence than dairy, native and mixed breed (Cutlip, R. C. *et al.*, 1992). Angora and pygmy goats are more resistant to CAEV infection than Saanen, by shared area with seropositive Saanen for 1 year (deMaar, T. W. *et al.*, 1995). Likewise Gufler's study, showed lower prevalence in pygmy than domesticated breed in Italy including Passeirer and mixed breeds (Gufler, H. *et al.*, 2007). Saanen and Toggenburg were more likely to seroconvert than Alpine breeds when they were raised with non-pasteurize milk (Rowe, J. D. *et al.*, 1992b).

11. Sex: Ratanapob et al. (2552) indicated that sample from female goats had more tendencies to give seropositive results than sample from male goats. On the other hand, a report from Bandeira, D. A. et al. (2009) mentioned that male goats were more likely to be infected with CAEV than female. Many studies have not found

relation between the sex of goats and seroprevence of CAEV infection (East, N. E. *et al.*, 1987; Rowe, J. D. *et al.*, 1991; Cutlip, R. C. *et al.*, 1992; Gufler, H. *et al.*, 2007).

12. Behavioural traits that could increase the risk of transmission include teat biting and sucking by does and leakage of milk before milking (Matthews, J., 2009a).

Pathogenesis

Lentiviruses only replicate in dividing cells. Retroviruses are not pathogenic and changed metabolism of infected cells. Lentiviruses are able to kill cells by many methods, including syncytium formation, apoptosis, and may continue to replicate and budding to a number of viruses (Murphy, F. A. *et al.*, 1999).

CAEV requires has 3 biological properties that to be able to infect perfectly and be persistent including;

1. Proposed mechanisms for persistence include latent infection by DNA provirus, proviral replication that waits for monocytes to mature or differentiate into macrophages after they leave the bone marrow or blood and localize in tissue sites. The virus localizes in the macrophages of the synovium, lung, associated lymph nodes, CNS, choroid plexus of the brain, and mammary gland which are the important target tissues of CAEV. At these target sites CAEV induces chronic inflammation by invoking the host's immune responses. Virus did not present in circulating monocytes. Lymphocyte proliferation is a hallmark pathologic lesion seen in CAEV infection.

2. CAEV infects monocytes and macropahges as their principal host type and induces a persistent (life-long) infection despite host antibody production. "Restricted replication" allows the virus to maintain latent in the host's monocytes and undetected by the immune system. But other cell types, including epithelial, endothelial cells and fibroblasts, are susceptible to in vitro infection with varying levels of viral replication (Lechat, E. *et al.*, 2005).

3. Low level of neutralizing antibodies, and viral mutation of *env* genes. Initially the virus proliferates rapidly and induces a vigorous immune response that limits but does not eliminate the virus. The virus is capable of making antigenic variants of itself to help it evade the host immune response (Reilly, L. K. *et al.*, 2002; Matthews, J., 2009a; Smith, M. C. and D. M. Sherman, 2009a).

Pathogenesis of the infected system

1. Arthritis; synovial membrane replicates cells, to be villous into lumen of the joint accompanied with characterized perivascular cuffs of mononuclear cells in synovial fluid, such as lymphocytes, plasma cells, and macrophages. Increasing synovial fluid, cause joint capsule, space inside the joint, tendon swelling. This fluid is more liquid than normal condition, blood liked color, or straw color, containing inflammation cells, fibrin fragments of synovial membrane, and debris of mineralization. Normally synovial fluid has mononuclear cell < 500 cells/ml, when

inflammation occur cells increase to 500,000 cells/ml or about 90% and primarily lymphocytes and has a decreased protein concentration. Inflammation and mineralization are result to fibrosis, necrosis at joint capsule, osteoporosis. The most severe case may be detected atlantooccipital and supraspinous joint capsule, tendon thicker and more fluid. Thicken of joint capsule affects to limited of the movement, flexion, shrinking of muscle. Cold weather can worse arthritis. If there is no complicated infection, the infected goat will afebrile, alert, appetite, even it can't move the body. When cartilage degeneration, all tendon in affected area will rupture. Finally inflammation cells become to source of virus and many of perivascular cuffing consists of a lot of plasma cells (Adams, D. S. *et al.*, 1980; Crawford, T. B. *et al.*, 1980; Narayan, O. and L. C. Cork, 1990; Knowles, D. P. *et al.*, 1992; Murphy, F. A. *et al.*, 1999; Reilly, L. K. *et al.*, 2002).

2. Mastitis; lesions consists of marked lymphoid heperplasia, which in the chronic cases become lymphoid nodules as seen in the joints. Many of these nodules are arranged adjacent to the lactiferous ducts. The inflammatory cells are of the same type as seen in the arthritic joints. Both the arthritic and mastitic lesions can be reproduced when young adult goats are inoculated with CAEV. (Narayan, O. and L. C. Cork, 1990; Knowles, D. P. *et al.*, 1992) The infected endothelial cells progress to expression of the viral p30 capsid antigen, suggesting viral proliferation. Such a process is occurring in vivo during angiogenesis and leucocyte homing to the mammary gland in the final third of mammogenesis, might contribute to viral spread in this crucial target organ (Lechat, E. *et al.*, 2005).

3. Encephalomyelitis; the inflammation is primarily at the white matter and meninges and is characterized by infiltrations of lymphocytes and demyelination. (Knowles, D. P. *et al.*, 1992) In acute stage of disease animal, in the cerebrospinal fluid mononuclear cells raise up to 100,000 cells/ml. These lesion consist of accumulations of mononuclear cells expand into the parenchyma. This inflammation is accompanied by destruction of myelin and proliferation by glial cells. Lesions in the spinal cord follow the same pattern, radiating from the perivascular regions and giving rise to demyelination. In the late stages inflammatory cells may become organized into germinal centers or focal accumulation of glial cells. Paralyzed animals may have residual demyelinated areas with no further evidence of ongoing inflammation. In necropsy, grossly lesions at CNS can be seen abnormal softly focal in white matter. When it was seen through microscope, showed group of mononuclear cell of inflammatory process and destruction of meninge. (Narayan, O. and L. C. Cork, 1990; Murphy, F. A. *et al.*, 1999)

4. Pneumonia; an interstitial pneumonia has been reported in infected kids and adults. It produces chronic pneumonia, weight loss, and dyspnea. Lesions occur predominantly in the caudal or cranioventral lobes. The lesion of CAEV interstitial pneumonia closely resemble those of OPP. Experimentally, the chronic interstitial lesions have not been reproduced with inoculation of CAEV (Belknap, E. B., 2002). In postmortem, affected lungs are not completely collapse, but swollen, firm to palpation and have 1 to 2 mm gray foci on cut surface. The alveolar septa are irregularly thickened with lymphocytes and macrophages. Lymphoid aggregates are present in some septa, usually adjacent to small vessels and bronchioles. Bronchial

lymph nodes are hyperplastic. (Knowles, D. P. *et al.*, 1992; Murphy, F. A. *et al.*, 1999)

In addition, fewer cells with viral transcripts are seen in noninflamed tissues (Zink, M. C. *et al.*, 1990).

Immunology

Disease results from inflammation elicited by the reaction of the immune system to the virus. Infected macrophages express viral proteins near major histocompatibility complex (MHC) antigens, which recognized by T lymphocytes and stimulate cytokine production. CAEV induces both a strong humoral and cell mediated immune response, but neither is protective to the host. In fact, CAE is an immunopathological disease in which lesions result from an immune reaction to viral antigens, especially surface glycoproteins. Very little is known about IgM antibody responses to lentiviruses. However, large amounts of virus-specific antibody are present in the IgG class and theses are found specifically in the IgG_1 fraction. (Johnson, G. C. *et al.*, 1983b) The affinity of these antibodies for gp140, and their lack of virus neutralization, has not been evaluated but the antibodies bind strongly to the p28 polypeptide. This antibody binding can be seen in a variety of tests including immunoprecipitation, AGID, ELISA, IF, and CF tests.(Narayan, O. and L. C. Cork, 1990) Virus-specific IgG_1 antibodies in serum as well can found in synovial fluid. (Johnson, G. C. *et al.*, 1983a) In stromal cells of bone marrow such as fibrocytes, endothelial cells, and adipocytes can detected immunolabel of CAEV, so these cells are accumulate of virus in subclinical goats. (Grossi, P. *et al.*, 2005) Interleukin-16 (IL-16) is proinflammatory cytokine which produce by lymphocytes, macrophages, mast cells, and eosinophils, while infection occurs. If there are no infection, these cells can little detected both in peripheral blood mononuclear cells and synovial membrane cells. IL-16 mRNA and IL-16 protein increase in circulation, by binding with CD4 to against viral integration and more activate of lymphocytes markers, observed at arthritic joint and inflammation of other tissue of CAEV infected goats. (Sharmila, C. *et al.*, 2002; Nimmanapalli, R. *et al.*, 2010)

CD8 positive cells in blood and milk were more numerous in CAEV positive goats when compared to negative goats. The content of cells expressing MHC class II molecules was higher in blood from CAEV negative goats, while the content of activated cells was higher in milk from CAEV infected goats.(Ponti, W. *et al.*, 2008)

About public health of lentivirus, CAEV may be transmitted to humans by goat milk consumption. It has been suggested that CAEV may also be involved in the immunological protection process against HIV, but this has not been demonstrated. The Tesoro et al study showed goat milk consumers' serum reactive to CAEV gp135, and one reacted against gp50 simultaneously. This may be the result of a repetitive stimulation without viral replication or the result of CAEV replication in humans. CAEV gp135 is codified by the env gene located on the viral particle surface as well as gp50. Moreover, there are similarities between CAEV gp135 and HIV-1 gp120, so there is a possibility that CAEV replicates in humans and may participate in immunological cross-phenomena, but this should be further studied. (Louie, K. A. *et*

al., 2003; Tesoro-Cruz, E. *et al.*, 2009) Moreover person that expose to CAEV, may get false positive result of HIV serology test. The diagnosis of HIV should consider in this point. (Tesoro-Cruz, E. *et al.*, 2003)

Treatment

No specific treatment or vaccine is available for CAEV. Most symptomatic animals are ultimately culled or euthanized because of lameness, recumbency, weight loss, or poor production. Supportive care for affected goats consists of

1. Nutritional management; the provision of high quality, easily digestible, readily accessible feed.

2. Foot trimming; goats with arthritic form of the disease require frequent proper of foot trimming, good pasture management, and soft and thick bedding to prevent trauma to the limbs.

3. Administration of NSAIDs; for pain relief and anti-inflammatory treatment. Such as flunixin meglumine, carprofen. (Matthews, J., 2009a) For short-period use, veterinarian may use extralabel of injectable NSAIDs, which are licensed for cattle showed in Table 2. For long-treatment use, oral medicine may be appropriate such as tablets, liquid or granules show in Table 3. They have been proven useful, although not specifically licensed for small ruminants, the dose should be reduced to the lowest effective dose. At lower doses, it may be possible to repeat the dose every 24 hours, but animals should be closely monitored. (Murphy, F. A. *et al.*, 1999) Some textbooks suggest phenylbutazone or aspirin 100 mg/kg PO BID. (Belknap, E. B., 2002; Reilly, L. K. *et al.*, 2002)

4. Corticosteroids; dexamethasone 0.2 mg/kg i.v. (Murphy, F. A. *et al.*, 1999).

5. Antibiotics may be beneficial to goats affected with interstitial pneumonia or mastitis if secondary bacterial infection is present (Cebra, C. and M. Cebra, 2002). A study of CAE in Ratchaburi suggested Sulfa (Chantakot, S. and M. Watthanakul, 2005).

6. Chemotherapeutics currently used for acquired immunodeficiency syndrome (AIDS) may be useful for instance zidovudine (AZT), interferon α and γ, interleukin-2, and antiviral agents (Cebra, C. and M. Cebra, 2002).

Table 2 NSAIDs dose for supportive treatment of CAE infection

Drug	Dose	Route
Carprofen	1.4 mg/kg repeat once after 24 hours	s.c. or i.v.
Flunixin meglumine	2.2 mg/kg sid for 3-5 days	i.v.
Ketoprofen	3 mg/kg sid for 3-5 days	i.m. or i.v.
Meloxicam	0.5 mg/kg repeat once after 36 hours	s.c. or i.v.
Tolfenamic acid	2-4 mg/kg repeat once after 48 hours	s.c. or i.v.
Phenylbutazone[1]	4 mg/kg	i.v.

[1]Phenylbuthazone is banned from use in food-producing animals in the EU

Source; Murphy, F. A. (1999)

Table 3 NSIADs for PO treatment

Drug	Dose	Route
Carprofen	1-2 mg/kg once daily	Oral
Meloxicam	0.4 mg/kg once daily	Oral
Aspirin[1]	50-100 mg/kg every 12 hours	Oral
Phenylbutazone[2]	10 mg/kg for 2 days, then once daily for 3 days, then every other day or as needed	Oral

[1]Aspirin is poorly absorbed by the rumen so relatively high doses are needed. Aspirin is not licensed for use in food-producing animals in the UK.
[2]Phenylbutazone is banned from use in food-producing animals in the EU

Source; Murphy, F. A. (1999)

Diagnosis

CAEV infection can be detected by various methods depend on if the target is an antibody or virus pathogen. Techniques to detect antibodies, which are produced by infected animals such as, agar gel immunodiffusion (AGID), ELISAs, Western blot and radioimmunoprecipitation assay (RIPA). The samples for serology tests are including serum, milk, and seminal fluid. (Ramirez, H. *et al.*, 2009) Viral isolation, observing cytophatic effect, dye antigen, PCR, RT-PCR, *in situ* hybridization are useful for histopathology, these are all effective techniques in detecting the genome that use for detecting virus antigen. Currently there is no **gold standard** for international accepted diagnose for CAEV infection. And there is no agreement between laboratories on the best test to use. However some reports took PCR to be a confirmation test or accompanied with Western blot and ELISA. If 2 methods' result are positive, then the sample is said to be positive, and is called an artificial gold standard (Ramirez, H. *et al.*, 2009). Belknap showed the use of the AGID test in conjunction with PCR testing is best for eradication and control purposes (Belknap, E. B., 2002). Viral isolation can be identified in live animals *in vitro* by co-cultivation of concentrated leukocyte preparations derived from blood, milk, or synovial fluid with goat synovial membrane in cell culture. At necropsy, suspect tissues from joint, lung, or udder can be cultivated directly in tissue culture flasks and examined for cytopathic

effect (CPE), which is manifested as development of refractile stellate cells and syncytia formation. When CPE is seen, presence of virus should be confirmed by immunolabelling or electron microscopy (Smith, M. C. and D. M. Sherman, 2009b). Physical examination and laboratory examination are also useful for diagnose CAEV infection. So cytology of the synovial fluid, radiology, and pathology are helpful for diagnosis (Knowles, D. P. *et al.*, 1992). No abnormalities are typically seen on hematology or blood chemistry except for mild anemia in some cases. Routine diagnosis is based on serologic testing (Reilly, L. K. *et al.*, 2002). Parturition or advanced stages of disease also may contribute to a false negative result. False positives may occur in goats younger than 90 days old that have colostral antibodies. For this reason it is often suggested that kids be at least 6 months old before they are first tested (Cebra, C. and M. Cebra, 2002).

Serology

Serology is the method that detects antiviral antibodies to identify infection. The antibodies detected are not protective against disease, but merely an indicator of infection, as only very low levels of neutralizing antibodies are produced in response to infection. In the past, immunodiffusion technique was the test of choice and widely used in the USA and Europe (Crawford, T. B. and D. S. Adams, 1981). But now many improved methods for testing CAEV infection are included agar gel immunodiffusion (AGID), indirect immunofluorescence, and enzyme immunoassays (Knowles, D. P. *et al.*, 1992; Murphy, F. A. *et al.*, 1999).

1. AGID test is the most widely used test because of its low cost and rapid results. It has good specificity and fair sensitivity (Reilly, L. K. *et al.*, 2002). The AGID is better than ELISA for herd screening that requires high specificity. With the AGID test, false negative may occur in goats that have not yet seroconverted to recent infection (Cebra, C. and M. Cebra, 2002). This test primarily measures antibodies against the viral surface glycoprotein gp135 and core protein p28 (Knowles, D. P. *et al.*, 1992). It was 90% of sensitivity, 100% of specificity when compare with ELISA and PCR methods (Karanikolaou, K. *et al.*, 2005).

2. ELISA test may detect infection earlier than AGID (Reilly, L. K. *et al.*, 2002). In general, ELISA tests are better for detect disease in an individual animal because the sensitivity of the test is higher than that of AGID (Cebra, C. and M. Cebra, 2002). In the original ELISA was measured anti-CAEV antibodies (Knowles, D. P. *et al.*, 1992), it has improved its techniques to be indirect ELISA (Krieg, A. and E. Peterhans, 1990), competitive-inhibition ELISA with 99.4% of sensitivity (CI; 98.4 to 99.8%), 99.3% of specificity (CI; 98.7 to 99.6%) when compare with AGID, and Western blot. Nowadays both of maedi-visna virus and CAEV antibodies can detected by ELISA (Saman, E. *et al.*, 1999). cELISA can detect ovine progressive pneumonia virus antibody, with 95.5% of sensitivity, and 100% of specificity, when match up to AGID and IP (Herrmann, L. M. *et al.*, 2003b). The other reports showed 100% of sensitivity and 96.4% of specificity, when compare with immunoprecipitation (IP), so it appropriate to eradicate the disease (Herrmann, L. M. *et al.*, 2003a). cELISA is a popular technique, because of the automatic read and analysis of the raw data, variant of antigen for example; whole virus recombinant, protein peptides containing

immunodominant epitopes synthetic peptides (Peterhans, E. *et al.*, 2004). Each type has a difference in ability to detected different virus. Some can detect only the similar of virus, if multi-strain infection, the result also unclear. The most appropriate method for detection of SRLV genotype E, antigen was made from whole virus (Reina, R. *et al.*, 2009), and merge the capsid antigen with the transmembrane to increase sensitivity of this method (Rosati, S. *et al.*, 2004). Skim milk also can be used to detect the antibodies of CAEV (Plaza, M. *et al.*, 2009). ELISA with PCR joined can be used to detect CAEV infection, because PCR can estimate proviral DNA even though negative result of ELISA (Andres, D. d. *et al.*, 2005; Gil, A. *et al.*, 2006). Seminal fluid can be used with ELISA (commercial branded Elitest) differ from popular technique for sera test kit (Chekit CAEV/MVV Antibody test kit and Pourquier ELISA Maedi-Visna/CAEV Serum Verification). The detection for CAE antibody in seminal fluid is useful in selecting semen for artificial insemination and as a way to control disease (Ramirez, H. *et al.*, 2009). ELISAs is a suitable method for screening test, many samples, higher sensitivity than AGID (Andres, D. d. *et al.*, 2005). ELISA also is an universal technique, capability to detect CAE antibody in whole blood, sera, bulk tank milk, milk, plasma. The last 2 kinds of sample can replace sera. Besides these Milk ELISA tests are being developed for bulk milk examination and could be an useful tool to monitor CAE levels in larger herds of unknown status. (Matthews, J., 2009a) Even there were less than 3% and 1% of prevalence by solution 1/10 and not diluted sample respectively (Brinkhof, J. M. A. *et al.*, 2010).

3. Polymerase chain reaction (PCR) assays can detect viral proteins in blood, milk, and tissue and may prove useful in diagnosing early infection (Reilly, L. K. *et al.*, 2002). PCR testing has a high specificity and sensitivity and can detect infection within a day of exposure (Cebra, C. and M. Cebra, 2002). This method has the advantage of detecting infected animals before seroconversion. (Peterhans, E. *et al.*, 2004; Matthews, J., 2009a) But if seroconversion has already happened the amount of virus decrease, so the sensitivity of PCR will be lower than ELISA (Andres, D. d. *et al.*, 2005). PCR has 56.7% of sensitivity, 100% of specificity when compare with AGID and ELISA (Karanikolaou, K. *et al.*, 2005). It can be use in a multi-test with ELISA (Andres, D. d. *et al.*, 2005; Gil, A. *et al.*, 2006) or AGID to get lower risk of false negative. (Modolo, J. R. *et al.*, 2009) PCR can detect proviral-DNA of CAEV from blood, flushing media of oviduct. (If the blood test results are negative, and oviductal fluid are negative too, then the results can be trusted.) (Fieni, F. *et al.*, 2002), oocytes, cumulus cells (Ali Al Ahmad, M. Z. *et al.*, 2005), mononuclear cells, semen (non-spermatozoa cells), genital tract tissue (testes, epididymis, vas deferens, and vesicular gland) (Ali Al Ahmad, M. Z. *et al.*, 2008a), vaginal secretion (Ali Al Ahmad, M. Z. *et al.*, 2008b). In sheep, detection of SRLV use PCR for long terminal repeat (LTR) and gag sequence from clotted blood, serum, and peripheral blood leukocytes, this showed improved of laboratory technique that can detect gag-PCR from clotted blood (Leginagoikoa, I. *et al.*, 2009).

4. Double-nested PCR used to detect CAEV proviral-DNA in semen (Travassos, C. E. *et al.*, 1999), embryo flushing media, mammary gland, mammary lymphnode, synovial membrane, pelvic lymphnode, uterus, and oviductal tissue (Fieni, F. *et al.*, 2002, 2003).

5. Nested-PCR used to detect CAEV proviral DNA in blood, tissue (Ali Al Ahmad, M. Z. *et al.*, 2008b), and semen (Cruz, J. C. M. *et al.*, 2009; Paula, N. R. d. O. *et al.*, 2009). Semen may be positive but infection through the semen is not confirmed.

6. Semi-nested PCR has high sensitivity and specificity similar to AGID, when using a blood sample (Eltahir, Y. M. *et al.*, 2006).

7. Reverse transcriptase polymerase chain reaction (RT-PCR) used to detect CAEV viral RNA from seminal plasma (Ali Al Ahmad, M. Z. *et al.*, 2008a).

8. Real-time PCR used to detect proviral nucleic acid sequences of SRLV from both sheep and goats' blood (Brinkhof, J. M. A. *et al.*, 2008).

9. Western blot and RIPA, both are extremely complex and costly, so they are only use as confirmatory tests. (Eltahir, Y. M. *et al.*, 2006) They require a specific antigen, however RIPA has a higher complexity and uses uncommon techniques. Western blot is more admired as a confirmation test after earlier being tested by ELISAs, it has a higher sensitivity than ELISA (Peterhans, E. *et al.*, 2004).

10. Northern blot, to look for mitochondrial RNA (mRNA) (Cebra, C. and M. Cebra, 2002).

The serology laboratories result meaning;

A positive result means that the goat has been infected with the CAEV and is a potential shedder of the virus, especially if lactating.

A negative result means that the goat either not infected or has been recently infected and is producing amounts of antibody too low to be detected. It cannot be assumed free from infection, because (1) routine tests are relatively insensitive and (2) the period between infection with the virus and seroconversion (i.e. production of detectable antibody) may be prolonged. (3) Antibody levels may fall as the disease progresses, so even a clinically diseased animal may test seronegative. Goats infected by contact or by drinking infected milk when adults may take 3 or more years to become seropositive. Kids infected postnatally generally seroconvert between 6 and 12 months of age. Some seropositive goats will periodically test seronegative. Animals tested seronegative on AGID or ELISA may test positive using PCR, i.e. provirus DNA is detectable before antibody production.

A suspect result may reflect recently infected animals, young animals who have received colostrums-containing antibodies or animals reacting abnormally to the test. Suspected animals should be retested. (Matthews, J., 2009a)

Many goats seroconvert after a period of stress or at parturition. Testing in late pregnancy will not necessary detects all does which seroconvert after kidding, and these animals will produced infected kids. (Matthews, J., 2009a)

Virology

Virus isolation

Virus isolation is not routinely performed (Belknap, E. B., 2002). It takes times 3 to 4 weeks and sensitivity is poor (Reilly, L. K. *et al.*, 2002). 10-20 ml of blood are collected in anticoagulant solutions (heparin, Alsever's etc.) and sent to the laboratory in plastic syringes. The buffy coat cells are separated and cocultivated with normal goat synovial membrane cultures. The coculture is maintained for at least 2-3 weeks at 37 °C and examined frequently for development of viral CPE. Alternatively, viral target tissues may be cultivated directly and the cellular outgrowths examined for CPE (Narayan, O. and L. C. Cork, 1990). Common sample for virus isolation was whole blood even a little of virus in sample, but there is challenged for detection of virus pathogen (Peterhans, E. *et al.*, 2004). While isolation of CAEV from synovial fluid provides a definitive diagnosis of infection, the procedures is expensive and time-consuming, requires special cell cultures and often times is nonproductive. The synovial fluid within a CAEV-infected synovial space characteristically contains mononuclear inflammatory cells 1,000 to 20,000 cells/ml, including lymphocytes, plasma cells and macrophages. (Knowles, D. P. *et al.*, 1992)

Other techniques

1. Radiographics; radiographs of joints show soft tissue swelling initially at joint capsules, tendons, tendon sheaths, and tissues in subcutaneous of the joint, at last mineralization of synovial-line structures in more advanced case. The most severe cases show osteochondrosis (Knowles, D. P. *et al.*, 1992; Reilly, L. K. *et al.*, 2002).

2. Histopathology examination; histopathologic examination of tissues may provide a diagnosis (Belknap, E. B., 2002). Necropsy is useful for confirmation cause of CAEV or other to that sickness, by collect intra-articular, CNS, mammary gland, or respiratory tissue such as lung (Knowles, D. P. *et al.*, 1992; Ali Al Ahmad, M. Z. *et al.*, 2008b), retromammary inguinal, and prescapular lymphnode, carpal synovial membrane tissue, uterus (Ali Al Ahmad, M. Z. *et al.*, 2008b). Postmortem examination usually reveals pathology in numerous joints in addition to the carpus. The joint capsule is thickened, often with periarticular, tendons and ligament mineralization, but articular cartilage is usually intact. Periosteal reaction accompanied with periarticular osteophyte production, degenerative joint disease with ulceration and erosion of the articular cartilages and destruction of subchondral bone. Histopathology examination shows chronic proliferative synovitis with infiltration by lymphocytes, macrophages, and plasma cells (Reilly, L. K. *et al.*, 2002). Subsynovial mononuclear cell infiltrates and hyperplasia. There are focal areas of necrosis within the synovial membrane or surrounding connective tissue. (Matthews, J., 2009a) In CNS, reveals widespread perivascular foci and demyelination of the white matter of the brain and spinal cord (Machen, M. R. *et al.*, 2002).

3. Examination of synovial fluid; reddish brown synovial fluid with larger numbers of cells (1,000 to 2,000 /ml), mainly mononuclear cells (cf. normal goats

<500 cells/ml) may contain fibrin tags. Locally produced antibody may be detectable in the fluid. (Matthews, J., 2009a)

Positive serological or virus isolation results are self explanatory for infection in the animal. However, since not all infected animals show clinical disease, identification of infection in clinically normal animals does not prognosticate eventual disease. These animals shed virus and would have to be culled from herds in any attempt to control the disease. (Narayan, O. and L. C. Cork, 1990)

Differential diagnosis

1. Arthrits may be a result from bacterial, mycoplasma, and chlamydial arthritides, as such must be differentiated from the CAEV. These bacterial and mycoplasmal arthritides are reported as an acute, febrile, suppurative polyarthritis of goat kids. The evidence for chlamydial arthritis in goats is sparse, if it is suspected, the *Chlamydia* spp. should be isolated from the lesions and an immune response to the organism demonstrated (Knowles, D. P. *et al.*, 1992). Other then these, tatanus a pathogen that can cause of arthritis (Matthews, J. G., 1999). However non-infection etiology can cause of arthritis for instance trauma and result of metabolism (Smith, M. C. and D. M. Sherman, 1994a).

2. Lameness can cause of osteoarthritis, foot rot, inter-digit dermatitis, abnormal overgrowth of hoof (Matthews, J., 2009b).

3. CNS signs include; listeriosis, vertebral body abscess, toxoplasmosis, enzootic ataxia, round worm infected to the brain, scapies (rarely proritus in goat), polioencephalomalacia, paralysis by tick infection, rabies. The etiology from non-infection factors are consists of congenital abnormal of vertebral bone or spinal cord, trauma, copper and vitamin E deficiencies, and oraganophospate poisoning (Knowles, D. P. *et al.*, 1992; Smith, M. C. and D. M. Sherman, 1994b).

4. Mastitis include; the common bacterial pathogens, *Staphylococcus* spp. *Streptococcus* spp. *Mycoplasma* spp. and a variety of gram-negative organisms (Knowles, D. P. *et al.*, 1992), and abnormalities such as edema of mastitis, metritis, and obstructed nipple (Smith, M. C. and D. M. Sherman, 1994c).

5. Pneumonia include; single or combined infections with other viruses, mycoplasmas, bacteria and fungi. (Knowles, D. P. *et al.*, 1992) Other causes should be considered because numerous agents may be responsible for the clinical presentation (Belknap, E. B., 2002). Lungworms may possibly predispose to this sign by inducing monocyte migration and macrophage proliferation in parasitized lung (Smith, M. C. and D. M. Sherman, 2009a).

6. Pathology of lymphnode has characterized granulomatous for example respiratory lymphnode, hepatic, and mesenteric lymphnode should be subjected to a differential diagnosis from caseous lymphadenitis (Pugh, D. G., 2002).

Prevention and control measures

A preventive program is the most important thing that can be done in terms of a CAE control program as there is currently no vaccine available. An efficient vaccine is not yet available due to the different responses from each host (Adebayo, I. A. *et al.*, 2002). An experimental vaccine is currently being test in young cow (Morin, T. *et al.*, 2003). In an experiment with dairy goats, they have inhibited viral most replication but still high replication of virus in lymphnode, and arthritis occurred within 84 weeks (Cheevers, W. P. *et al.*, 2003). In another study they focus on a group of genetically defined goats. The goats were immunized with a synthetic peptide, which is known to encompass an immunodominant helper T-cell epitope of caprine arthritis encephalitis virus (CAEV). Subsequent to 55 days after vaccination with the molecularly cloned CAEV strain CO, the vaccinated animals had a higher proviral load than the controls. Gamma interferon and interleukin-4 gene were trustworthy markers of an ongoing immune response but their balance did not account for more or less efficient control of CAEV replication. On the contrary, granulocyte-macrophage colony-stimulating factor appeared to be a key cytokine that might support virus replication in the early phase of infection. This report demonstrated that lentivirus-specific T cells can be harmful to the host. (Nenci, C. *et al.*, 2007) And also method to eradication pathogen from the infected animals, and specific treatment are absent. So it is seriously for taking strictly measurement and objective to decrease within herd prevalence such as screening test by serology, the ability to identify infected animal, and culling them. (Knowles, D. P. *et al.*, 1992) This section shows more details about the prevention, especially maintaining CAEV-negative herds because CAEV is lifelong infection.

1. Separation and testing new animals within 60 days of arrival (Reilly, L. K. *et al.*, 2002) before mixing with preexisting population are important, as is routine testing of animals to decrease incidence of seroconversion (Belknap, E. B., 2002; Reilly, L. K. *et al.*, 2002; Matthews, J., 2009a).

2. Kids from infected or suspicious does should be removed immediately after birth to prevent nursing because licking of the kid by the doe may allow transmission of CAEV, presumably via saliva. And the new born should not contact secretion of its does (Knowles, D. P. *et al.*, 1992; Belknap, E. B., 2002; Reilly, L. K. *et al.*, 2002). This method can decrease more than 90% of infection rate, even parturition through vagina and fed its kid with heat treated colostrums at 56°C (133°F) for 1 hour, pasteurized goat milk, cow milk, non-infected goats' milk, along with separated raising from infected animals (Nord, K. *et al.*, 1998a). Separation of kids from their infected dams and not feeding with their own dams' colostrums in the report of Crawford and Adams (1981) reviewed kids remain sterile from CAEV for at least 2 years and decreased 35% of number of seropositive goats (Leitner, G. *et al.*, 2010). In negative serology herd, does and kids can naturally raising together (Sanchez, A. *et al.*, 2001).

3. Feed kids with heat-treated colostrums at 56°C (133°F) for 1 hour (at this temperature the virus is inactivated but the immunoglobulins remain intact), cow colostrums, and pasteurized (74°C (165°F) for 15 seconds) milk or milk replacer until they are weaned. Kids fed pasteurized milk are less likely to seroconvert than kids fed

unpasteurized milk. (Knowles, D. P. *et al.*, 1992; Belknap, E. B., 2002; Reilly, L. K. *et al.*, 2002)

4. Pooled milk should never be fed to kids. If a doe subsequently proves to be a virus carrier, only her own kids will have been infected. Also no milk from another herd should be fed under any circumstances.(Matthews, J., 2009a)

5. At least every 6 months, or twice a year (Nord, K. *et al.*, 1998a) keepers should test kids, and more than 6 months of age for CAEV and culled animals that test positive (Narayan, O. and L. C. Cork, 1990; Knowles, D. P. *et al.*, 1992; Nord, K. *et al.*, 1998a). Many studies defined 'CAEV free' in differently of seronegative time duration, such as after 2 successive testing periods (Belknap, E. B., 2002; Reilly, L. K. *et al.*, 2002), minimum of 5 years and preferable more with no evidence of infection in the herd during that time (Matthews, J., 2009a). Culled infected animals from the herd is important for protect lateral virus transmission (Leitner, G. *et al.*, 2010). Any sheep in contact with the goats should be tested at the same time. If mention about infected animal culling, it is more difficult because of almost of infected animal did not show clinical signs such as 81.5% of prevalence in Italy, but only 2.5% of clinical sign animals (Gufler, H. *et al.*, 2008).

6. After culling of seropositive animals, the farm equipments, house of goats, and area around the farm should be clean, disinfect, and leave it free for 3 months. This control program took in 230 goats routinely test by ELISA for 3 years range, explored the 97% of prevalence in Norway decreased to only 6 seropositive animals, 10 uncleared test results, and none of CAE clinical sign or caseous lymphanitis in animals (Sanchez, A. *et al.*, 2001).

7. Segregation of seropositive and seronegative does by a solid wall or 2 m alley is advisable (Reilly, L. K. *et al.*, 2002).

8. In a dairy herd, CAEV-infected does should be milk last (Reilly, L. K. *et al.*, 2002).

9. Embryotranferation from CAEV infected does to non-infected does can result of free CAEV kid CAEV (Ali Al Ahmad, M. Z. *et al.*, 2008b).

10. Control measurement should be done in both of goat and sheep (Pisoni, G. *et al.*, 2005) In some area such as Italy had commonly SRLV subtype B1 infection, even through rarely of mixed goat herd with another animals. There assumed eradication program in goat will success, if separated raising goats from sheep (Gufler, H. *et al.*, 2008). In Switzerland suggests that sheep can play an important role in infecting goats and that any eradication or control program should include sheep as well as goats. (Matthews, J., 2009a)

11. Chemical disinfection of equipment between use with seropositive and seronegative animals should include the use of phenolic and quarternary ammonium compounds (Reilly, L. K. *et al.*, 2002).

12. Aseptic technique can decrease iatrogenic transmission by needles or instrument (Reilly, L. K. *et al.*, 2002). They should be used only once and then discarded. Proper sterilization of surgical equipment also is warranted (Machen, M. R. *et al.*, 2002).

MATERIALS AND METHODS

Materials

Material for data gathering

1. Designed the questionnaires for gathering data of all goat farmers (questionnaires A). Questionnaires consists of general data of farmers such as age, education level, religion, and detail of farm management, with interested in which factors that may be associated with CAEV infection including time raising of farmer, which was continuous data, total goats, raising goat farm as a main or additional career to reviewed for the differences in paying attention to their farm. The place of housing; in the area of their house or the other location. Rearing with sheep, other animals, joined with other goat herds in the field grazing, borrowing buck, health status of replacement or new goats that will move into the farm, new born feeding management, milk bottle used, weaning management, owning of farm equipment, taking ear tag, taking multiple-used needle, remove feces from goat house, frequency of disinfectant goat house. History of clinical signs that result of CAEV infection within 1 year within farm including 4 main organ systems of CAEV infection; arthritis, encephalomyelitis, pneumonia, and mastitis. Density of goat/metre square, material of the floor of goat house, height of the floor of goat house from the land, health status of new goat, sick goat management, boiling colostrums for kids. Collect to analyze risk factors of seroprevalence of CAE (Al-Qudah, K. *et al.*, 2006; Bandeira, D. A. *et al.*, 2009; Ghanem, Y. M. *et al.*, 2009; Chanlad, S. and S. Prasitphon, 2010).

2. Designed the second questionnaires to get expert opinions (questionnaires B) by the criteria of experts are at least 5 years experience of working in a goat related field, and at least 1 paper published about goat. Questionnaires consists of self-answer questions regarding CAE status, percentage of goat number that bring into farm/year, probability of shedding CAE by new goats that did not check health status before move onto a farm, probability of mistake from mislabeling infield practice, laboratory, and transportation quality. Experts were asked to fill the confidence level in the answers for each question so the uncertainty to the answers can be analysed.

Material for serum collection

1. Vacuum-syringe 10 ml. with small plastic tablet for encourage blood clotting totally 2,100 syringes.
2. Plastic needle No.18, 1 inch 2,100 needles.
3. Cotton 1 kg.
4. 70% Alcohol 450 ml. 12 bottles.
5. Ice buckets for store samples in the field 3 buckets.

Material for diagnosis CAEV infection

1. Competitive ELISA test kit with sensitivity 100%, and specificity 96.6% (Ghanem, Y. M. *et al.*, 2009) 2,000 kits.
2. Micropipette
3. Wave length reader for ELISA

Methods

Interview goat farmers

Interview all goat farmers in Chainat province, using questionnaires A to get data. Sample size calculated number of farms to collect data by estimate percentage equation.

$$n = \left(\frac{t \times SD}{L}\right)^2$$

Where; n = required sample size
t = Student's t-value (e.g. 1.96 when the desired level of confidence is 95%)
L = the accepted absolute error or precision (e.g. 5%)
SD = the standard deviation $SD = \sqrt{P \times (1-P)}$
P = prevalence (P of 10% = 0.1)

Then calculated the sample size of animals/farm by detection of disease equation.

$$n = \left\{1 - (1 - CL)^{\frac{1}{d}}\right\} \times \left(N - \frac{(d-1)}{2}\right)$$

Where; n = required sample size
N = population size
D = number of expected diseased animals in the herd or expected prevalence
CL = confidence level as a fraction (e.g. 0.95)

The results are showed in Table 4 and then in animal level, calculate sample size by the same equation but use number of goats within farm instead of number of farms. The results are showed in Table 5. In animal level, sample size had to individual calculated because of the variation of number of total goats in each farm. If there were less than 20 goats, collect all samples from goats that more than 6 months of age, because it can't be calculated by the equation. If there were equal of more than 20 goats, collect sample by the result of calculation.

Table 4 Calculation sample size farm level

Parameter	Farm level
Population Size	66
Expected Prevalence	50
Accepted Error	5
Level of Confidence	95
Sample Size	57
Use	61

Table 5 Calculation sample size animal level

Parameter	Animals/farm
Population Size	80
Expected Prevalence	10
Level of Confidence	95
Sample Size	25
Use	25
Total	1,525

Serum collection

Collect serum from jugular vein of every goat which aged over 6-months, using 10 ml vacuum-tube that was not anti-coagulation agent and let blood clot and centrifuge at 2,500 rounds/minute for 15 minutes to get serum. Store serum at 4 degree Celsius until do the competitive ELISA for detecting antibody of CAEV at National Institute of Animal Health (NIAH) of DLD.

Statistical analysis

Data from questionnaires and laboratory result organize by using Epi Info 3.5.1 for statistics descriptive data analysis, and STATA 8.2 for univariate logistic regression at $p<0.05$ to estimate significant of each risk factors associated to seroprevalence of CAE within goat herd including; time raising of farm (years), raising goat farm be main or additional career, herd size divided by mean and mode of total goats, rearing with sheep, rearing with other animal, joined other goat herd in the field grazing, borrowing buck, using multiple-used needle, main clinical signs of CAE in goats within farm during one last year; arthritis, dyspnea, seizure, and mastitis, density of goats (goats/m^2). Then put the significant risk factors in multivariate logistic regression by enter method at $p<0.05$ to estimate the risk factors that associate to the seroprevalence of CAE.

Expert opinion data collection

Ask persons that match with criteria of expert to get data because of a lack available data and literature reviews (Garabed, R. B. *et al.*, 2009), as well as bootstrap simulate data, and use distribution to analysis probability along the biological pathway of quantitative risk (introduction level) of no test new goat bring CAE into

farm Figure 1. Compare to the other biological pathway Figure 2 that test CAE before moving new goats to the destination farm to know the difference in quantitative data. Uncertainty of data was estimated by bootstrap simulation method, and brought data to calculation in @Risk Palisade. Using pert distribution for number of goats that will be brought onto a farm (goats/farm/year), uniform distribution and beta distribution for probability of bringing CAE with new goats, and in tested CAE goats before bring into farms multiply by and probability of true negative and false negative (specificity of the test). But there exclude probability of true positive and false positive (sensitivity of the test). Because the positive goats will reject from the process, so there's no risk.

General approach of quantitative risk assessment

1. Definition of the unit analysis

This thesis has considered Chainat province as the unit of analysis for the risk question. The risk question is what is the probability of at least one animal infected, from spreading CAEV annually when introduced to a farm (introduction level)? Then compare no test with test before animal move into the destination farm. In real situation there is no test before bringing new goats onto a farm. This comparison will be useful for the prevention and control measurement of CAE infection. And the biological pathways divide into 2 pathways; no test on imported goats before move into the farm show in Figure 1, and the last one is testing by cELISA before import goats into farm showed in Figure 2.

2. Model formulation

The probability of introduction of CAEV into goat farm (at least one animal) via the import of new goats during 1-year period was model as a binomial process equation

$$P(x \geq 1) = 1 - (1 - p)^n$$ (Murray, N., 2004)

Where; n = the number of imported goats/farm/year
p = the probability of an infected animal was introduced into the establised farm
x = the outcome, an infected recipient

3. Definition of distributions for input variables

All of the distribution, use bootstrap simulations to put the uncertainty of data into the model.

3.1 Number of imported goats

Using pert distribution to calculate by inputting minimum, most likely value, and maximum of number of imported goats from unknown source values by asking expert opinion.

3.2 Probability of bring CAE into farm via imported goats or prevalence of CAE in imported goats

Using a Bayesian analysis; a beta distribution, which characterized by 2 parameter consists of alpha and beta. The data for calculate be alpha and beta collect by asking expert opinion by uniform distribution of probability with minimum and maximum value of bring CAE into farm via imported goats or prevalence of CAE in imported goats. Getting alpha and beta for put in primarily calculation for the beta distribution by equations consist of mean = a/(a+b), mode = (a-1)/(a+b-2), and variance = $ab/((a+b)^2(a+b+1))$ (Su, C.-L., 2010).

3.3 Sensitivity and specificity of the cELISA

The sensitivity of cELISA in this test was 100%. The specificity was 99.6%. But in the real situation, they could not be constant to these values. Because of sampling method, stratified sampling, collection sample, sensitivity of surveillance system can reduced the sensitivity and specificity of the test. This thesis uses 4 simulations of sensitivity and specificity for the quantitative risk assessment including 0,0.85, 0.95,1 and 0, 0.85, 0.95, 0.996 respectively. 0,0 means no test before bringing imported goats onto a farm. The last simulation is the sensitivity and specificity of the cELISA, which used in estimated prevalence of CAE in Chainat province.

4. Analysis of results

Because of variation of variables used on the formulation of the model and of the difficulty in estimating these values of parameters in the field, sensitivity analysis is an important process in the nature and extent, if any, in which variables is likely to influence the outcomes of the model by using correlation coefficient function in the software. The risk factors from this thesis are not put in the model, because they are not involving the introduce of imported goats into farm.

5. Model environment and software

The model was run 5,000 times, 4 simulations using a Monte Carlo approach implemented on a commercial software (@Risk version 5.5)

Time table

Table 6 Time table of the thesis

Operation details	Oct. 09	Nov. 09	Dec. 09	Jan. 10	Feb. 10	Mar. 10	Apr. 10	May 10	Jun. 10	Jul. 10	Aug. 10	Sep. 10	Oct. 10
Test the questionnaires													
Survey goat farms in Chainat													
Interview by using questionnaires													
Serum collection													
Collection data													
Test the serum at NIAH													
Data analysis													
Summary and report													

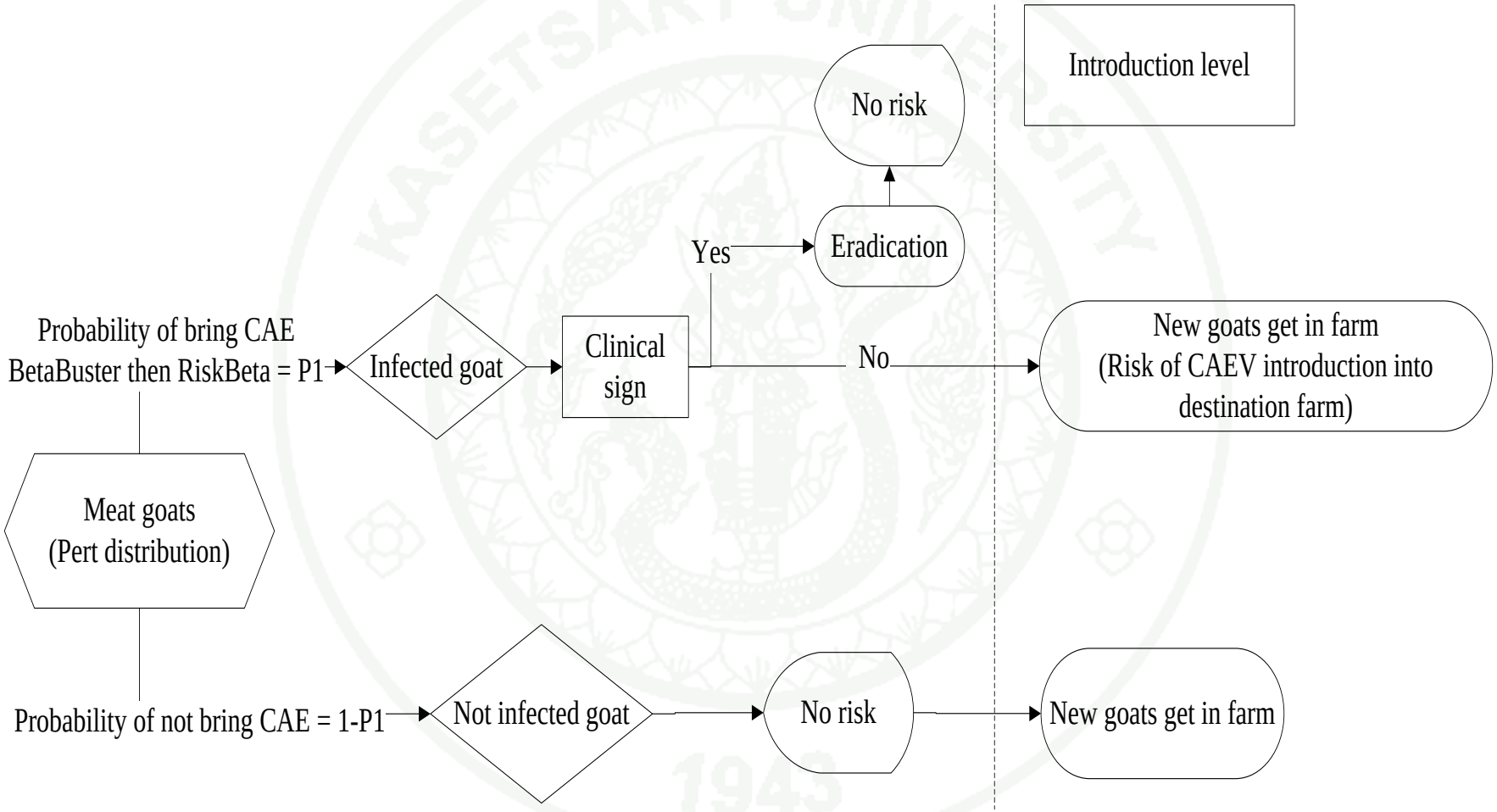

Figure 1 Biological pathway of bring new goat onto farm without CAE test.

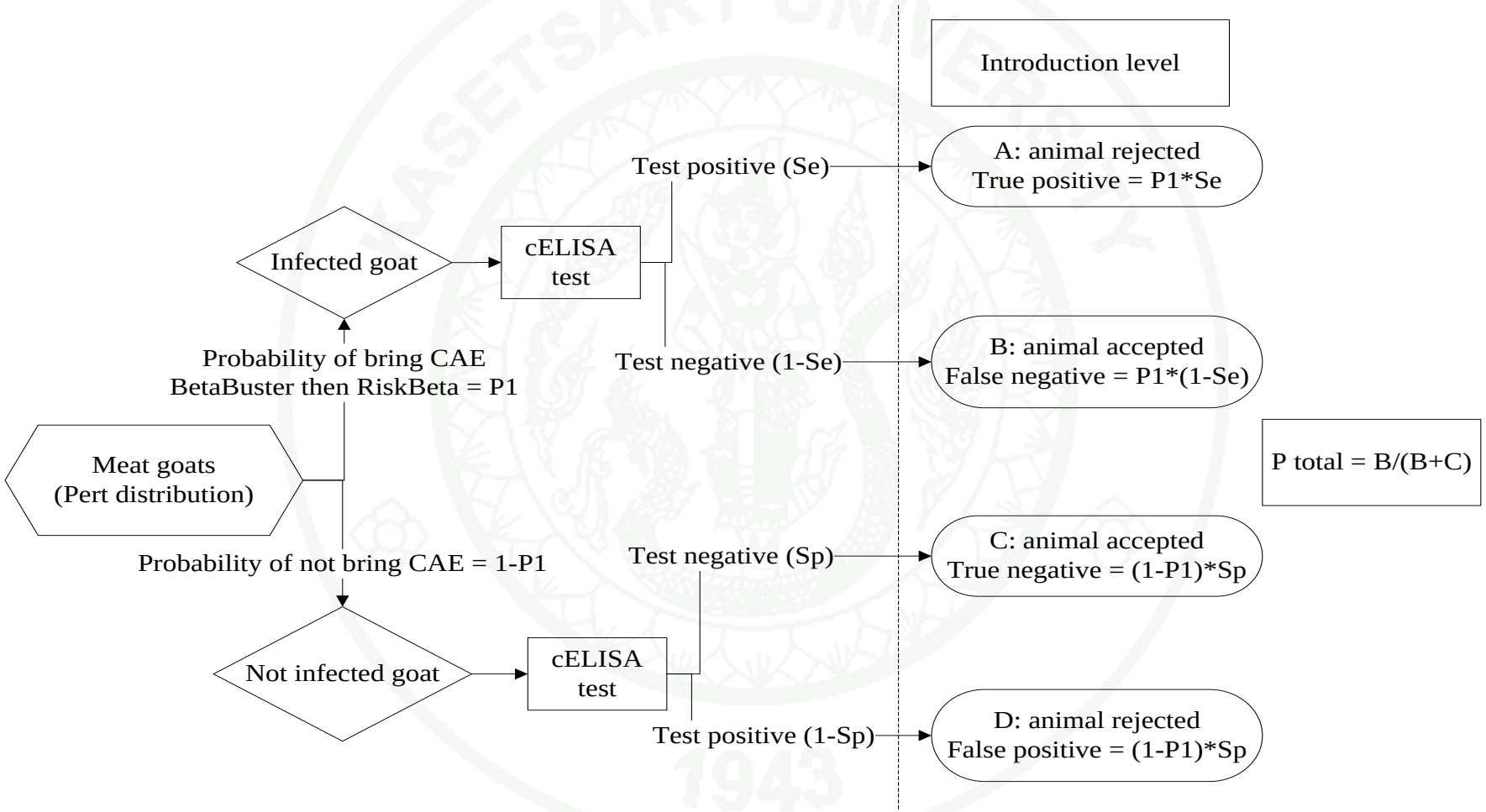

Figure 2 Biological pathway of tested CAE in new goat before move onto farm

Place and Duration

At Chainat province during the first of October 2009 to the first of October 2010.

RESULTS AND DISCUSSION

Results

Descriptive statistics

There are 112 documented farms, but many of them raised goats together in a herd. The herds were mixed owner herd that could have up to 10 owners. Some different names were husband and wife, or father and his children, or mother and her children where the data should have been from one herd. So, this study assumed these owners as one farmer for each farm to made them more realistic. The total number of farms was 66 farms but serum samples of 5 farms were bad quality not suitable for the test and were excluded from the analysis. The final total for this study was 61 farms, 1,333 sera. The range of age of farmers was 20 to 72 years old (mean 48.83, mode 62, median 49.5) with experience or time raising of farm goat between 0.25 to 12 years. Two-third of the farmers raised goats as an additional career. Ninety percent of the farms raised goats in the house area and share parts of living space with the farmers. Eighty-four point two percent (48/57) of them raised goats as breeders and meat-type goats. The meat-type goats were sold by weight. The rest 10.5% (6/57) raised only for finishing, 3.5% (2/57) only for breeding, and 1.8% (1/57) was the middle man for sale and buy goats. All of goat farmers are Buddhist. Total goats in their farms varied from 12 to 700 goats, with mean of 80.67, mode of 80, and median of 66. Range of density of goats per square meter was 0.03 to 4.48, with the mean of 1.15. Ninety percent of the floor of goat house made by wood, the rests made from ground, cement or both ground and wood. Time range of grazing was average at 5 hours/day. The range could be separated to 2 ranges including late in the morning and evening or grazing for the only one time for the whole 5 hours. There were only 2 farms that feed goats indoor.

Table 7 Seroprevalence of CAE in goats in 8 districts of Chainat province

District	Farms	Serum	Seropositive farm	%
Muang	3	77	0	0
Manorom	14	323	3	21.43
Wad Sing	4	80	0	0
Nhongmamong	12	213	2	16.67
Nernkham	5	105	1	20
Hanka	7	145	0	0
Sappaya	7	167	1	14.29
Sanburi	9	223	0	0
Total	61	1,333	7	11.47

Seroprevalence

At least 1 goat serum was seropositive which means the farm has the disease. From the criteria demonstrated result of 7 seropositive farms of a total 61 farms. Apparent herd seroprevalence was 11.47%. True herd seroprevalence was 11.51%, which more detail in the next section. Cut off point for categorized herd into 2 sizes was mean and mode equal 80 goats to less than usually herd size means less than 80

goats, if equal or more than 80 goats called equal or more than usually herd size. Seroprevalence of each districts were show in Table 7.

True prevalence

Seroprevalence value 11.47%, sensitivity 100%, and specificity 99.6% put into equation of true prevalence

$$PtRt = \frac{PaRt+(Sp-1)}{Se+Sp-1}$$ (Toma, B. *et al.*, 1999)

Where; PtRt = true prevalence rate
Se = sensitivity of test
PaRt = apparent prevalence rate
Sp = specificity

$$PtRt = \frac{11.47+(0.996-1)}{1+0.9960.} = 11.51\%$$

Univariate logistic regression

Factors in herd level that associated with seroprevalence of CAE, significantly at $p<0.05$ were time raising (years), herd size, and mastitis, as in Table 8.

Multivariate logistic regression

All significant factors in univariate analysis ($p<0.05$) were used to multivariate logistic regression, tested the fit of model by Hosmer and Lemeshow's goodness of fit test, chi-square 1.464, $p=0.993$, means the model was appropriate to the data. Risk factors that associated to seroprevalence of CAE were time raising (years) and herd size. Mastitis is also in the model but could not be concluded to be a risk factor, because it is a result of CAEV infection, so history of mastitis within 1 year in that farm, tend to found seroprevalence in farm Table 9.

Table 8 Univariate logistic regression of factor that associated to seroprevalence of CAE within goat herd

Factors	Details	Serology lab result		OR	95% CI	P
		positive	negative			
Time raising	Years	7	54	1.58	1.10-2.28	0.014
Career feeding goat	Main	3	38	0.32	0.06-1.61	0.17
	Additional	4	16	3.08	0.62-15.39	0.17
Herd size	Less than usually (<80)	1	38	0.07	0.01-0.63	0.017
	Equal or more than usually (≥80)	6	16	14.25	1.59–128.09	0.017
Rearing with sheep	Yes	1	7	1.09	0.11–10.49	0.937
	No	6	46			
Rearing with other animal	Yes	7	50	77,382.31	0.00->10^{-12}	0.96
	No	0	3			
Joined other goat herd	Yes	2	18	0.89	0.15-5.33	0.89
	No	4	32			
Borrowing buck	Yes	1	6	1.47	0.15-14.77	0.74
	No	5	44			
Used needle	Yes	7	45	222,990.81	0.00->1.0E12	0.97
	No	0	5			
Arthritis[1]	Yes	1	4	2.04	0.19-21.40	0.55
	No	6	49			
Dyspnea[1]	Yes	5	23	3.26	0.58-18.35	0.18
	No	2	30			
Seizure[1]	Yes	2	7	2.63	0.42-16.26	0.30
	No	5	46			
Mastitis[1]	Yes	5	16	5.78	1.01-32.98	0.048
	No	2	37			
Density of goats (goats/m^2)	≤1.5	4	40	2.73	0.53-14.04	0.23
	>1.5	3	11			

[1] means history of clinical sign in goats occurred in farm within 1 year.

Table 9 Multivariate logistic regression of risk factors that associated to seroprevalence of CAE in goat herd

Factors	β	SE	P	OR	CI
Time raising (years)	0.5746	0.2814	0.041	1.78	1.02-3.08
Herd size	3.092	1.353	0.022	22.02	1.55-311.92
Mastitis	3.409	1.427	0.017	30.23	1.85-495.11
Constant	-11.826	3.411	0.001	-	-

Quantitative risk assessment

A total of 9 expert opinions response from 12 experts who agree to answer the questionnaires B including 2 lecturers and clinicians from an university, seven DLD's veterinary officers; one from Chainat province, one from Ratchaburi province, four from laboratories, one from central part of the Department of Livestock Development. Bootstrap technique was used to handle data from the experts (Table 10) and the sampling data were put in a pert distribution for the number of imported goats. The bootstrap data from Table 11 were used for parameters in Beta Buster® to determine the parameters, alpha and beta, for beta distribution in @Risk. The data for Beta Buster® were 95% sure that CAEV greater than 0.2 and mode at 0.4. The software calculated the parameter for alpha and beta which were5.025 and 7.0375. Multiply the data along the biological pathway. The model is reviewed in Figure 3. The mean of probability of introduction of at least one goat infected with CAEV into goat farms via the imported goats during 1-year range without prior test equal to 1 (5^{th} percentile; 1, 95^{th}; 1), this value was reduced to 0.8137 by adding the prior test with 85% of sensitivity and 85% of specificity (5^{th} percentile; 0.35, 95^{th}; 1). The risk was even reduced to 0.5070 in the condition of prior testing with 95% sensitivity and 95% specificity test (5^{th} percentile; 0.13, 95^{th}percentile; 0.89). Finally the 100% sensitivity and 99.6% specificity which is the company's claimed test performance resulted in the risk of 0. Prevalence and the numbers of goats imported are the most two important factors that influenced the model. The probability of introduction of CAEV into goat farm could be decreased by test the animal before bringing new goats. 1.23, and 1.97 times with the test with performance of 0.85 sensitivity and 0.95 sensitivity, respectively when compared with no test.

Table 10 Data of number of new goats move onto farm/year from expert opinion

ID	Minimum	Most Likely Value	Maximum
1	1.5	25	50
2	0	5	50
3	2	20	30
4	0	0	30
5[1]	50	400	1500
6	5	20	50
7	10	30	50
8	2	30	30
9	1.5	15	50
Bootstrap	2	20	50

[1]means exclude from the bootstrap because of strongly difference from the other's data, and showed isolation from the distribution

Table 11 Data of probability of non tested new goats will introduce CAEV to the established farm

ID	Minimum	Maximum
1	1	60
2	0	60
3	50	80
4	0	100
5	50	100
6	20	90
7	1	25
8	20	90
9	1	5
Bootstrap	20	60

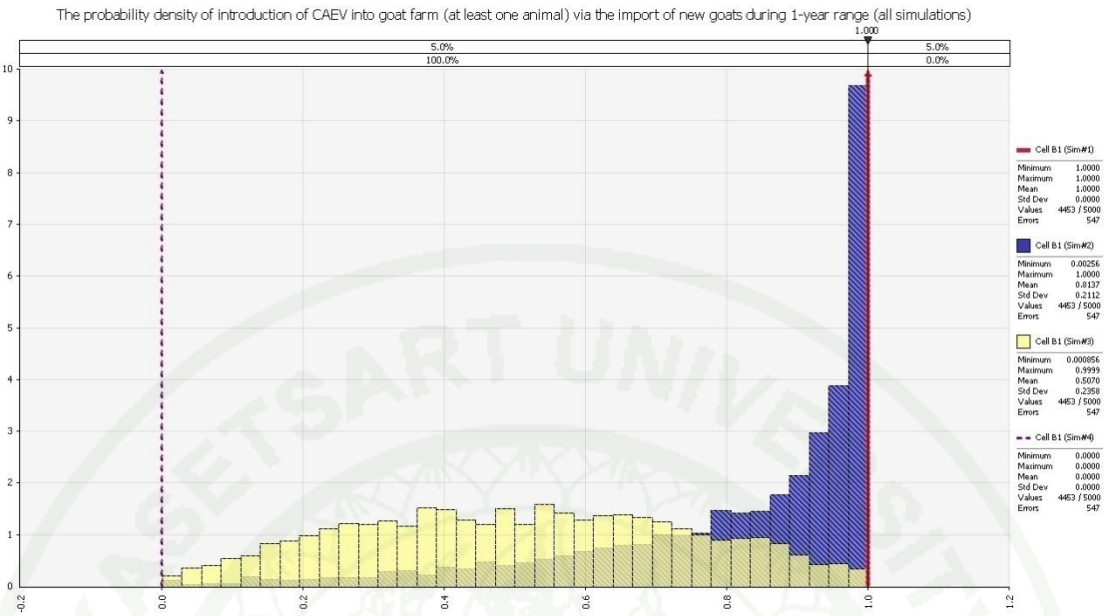

Figure 3 All simulations of probability of at least one goat infected

Figure 3; the red solid line was the simulation of no test prior entering a farm, the blue color was the distribution of risk with 85% sensitivity and 85% specificity of the surveillance system, yellow color was the distribution of the risk with 95% sensitivity and 95% specificity, the purple dot line was the risk of 100% sensitivity and 99.6% specificity.

Discussion

This study revealed herd seroprevalence of CAE in meat type goat in Chainat province was 11.51%, correspond to 9.46% of the previous study in the central and western part of Thailand (Ratanapob, N. *et al.*, 2009), but less than 37.25% of the study in Prachuabkirikhun (Chanlad, S. and S. Prasitphon, 2010) and 21% of a goat farm in Ratchaburi province (Chantakot, S. and M. Watthanakul, 2005). The difference may cause by different test methods of each study such as indirect ELISA (iELISA) (Ratanapob, N. *et al.*, 2009), precipitation line (Chantakot, S. and M. Watthanakul, 2005). Those tests have lower sensivity and specificity performance. There is no gold standard method for CAE diagnosis, but cELISA has the advantages when compared with AGID or PCR or viral culture. The later tests require multifactors such as budget, laboratory ability, time range. Moreover increasing of number of goats within farm can result increasing opportunity to found seropositive.

The prevalence of 11.51% in Chainat was lower than goat dairy industries countries, such as 23.2% in Jordan (Al-Qudah, K. *et al.*, 2006), 81.5% in Italy (Gufler, H. *et al.*, 2008), on the other hand the prevalence was higher than agricultural countries that actively import goats, where prevalence is usually less than 10% (Smith, M. C. and D. M. Sherman, 2009b) as seen in such countries *i.e.* , 1.9% prevalence in Turkey (Burgu, I. *et al.*, 1994), 6% in Somalia (Ghanem, Y. M. *et al.*, 2009), 8.2% in Paraiba state of Brazil (Bandeira, D. A. *et al.*, 2009), 3.6% in Yucatan,

Mexico, however, Prevalence in Rio de Janeiro state of Brazil was an exception at 14.1% (Lilenbaum, W. *et al.*, 2007). In goat dairy industry countries, the goats have been raised for a long time with high density of goats and poor biosecurity of farm management. CAE is a chronic disease, most infected goats do not show clinical sign, infection is lifelong, infected bucks and does are shedders within farm. These are the reasons of high prevalence in industries countries.

Risk factors that associated to CAE seropositive were experience of the owner. It is a continuous datum with year unit. Actually this factor is indirectly referred to the age of the farms. Older farms tended to have more diseases and it was proven here that the old farm was the risk factor of having the CAE. The disease is a chronic disease, and prolongs direct contact transmission. Once the disease is in a farm, it will be very difficult to eradicate it. Breeders, bucks and does, that stay longer in the farms could be carriers for CAE. The breeders could transmit the disease directly to the other animals.

Herd size factors correspond to many reviews that farms with more number of goats in herd would be more risk to be a seropositive farm, because bigger farms tended to have higher density of animals and worse biosecurity and sanitary management (Al-Qudah, K. *et al.*, 2006; Gufler, H. *et al.*, 2007). Therefore, it is more likely to transmit the disease. Larger farms had higher risk of having CAE, for example large herd (>100 goats) compared with medium (51-100 goats) and small herd (10-50 goats), where 72% of farm were large herd size (Al-Qudah, K. *et al.*, 2006), or with the cut off at median 42 goats to stratify into 3 groups of herd size consisted of >40 goats compared with 20 to 40 goats and <20 goats (Ghanem, Y. M. *et al.*, 2009), corresponded to one study in Thailand (Chanlad, S. and S. Prasitphon, 2010) >45 goats compared with ≤45 goats. This study was taking cut off by mean and mode of 80 goats/farm, not a median like the above others and the herd size was detected as a risk factor for the disease. However, herd size was not a risk factor in the study of Cutlip, R. C. (1992).

Mastitis is a clinical sign of CAE. Farm that had history of mastitis goat within one tended to get seroprevalence of CAE. Because mastitis is not an obvious sign in meat goat, but if it occurred, it could be a warning signal to check for CAEV infection. It should be considered that many etiologies can cause mastitis. Arthritis and encephalitis are dominant clinical signs of CAE but they were not significant factors in this study. Farmers may misunderstood arthritis as a result from accident falling down into narrow space between small wooden striped floors of goat house. Besides the accident, there are many diseases such as foot and mouth disease, metabolism, infection diseases or trauma that cause lameness. Encephalomyelitis and pneumonia also have many causes of the clinical sign. In the questionnaire A did not include heperpnea nor tachypnea, there was only dyspnea. This may allow loss of data by the questionnaires design. None farmers fed boiled colostrums to newborns instead they let does fed her kids by themselves. Except in twin or triple kids they prepare replaced milk, can be UHT milk, fresh cow milk, or force the other does to feed kids. So this thesis did not analysis boiled colostrums factor to associate to seroprevalence.

In the quantitative risk assessment, all the data and opinions came from experts in the field because of lacking of published data or document involved both

goats and CAE. However, it is surprisingly revealed that testing the imported goats prior to letting them commingle in the farms is very important. The practice can reduce the risk for almost 2 times if the test performance is good. The quarantine which mostly done with poor sanitary can increase the risk to 0.56 of probability of spreading disease (Al-Qudah, K. *et al.*, 2006). It is the result of mixing goats from many sources with unknown health status and high density at quarantine place. So this factor should be estimated in further study. Subsequent of the quarantine can make the rapidly, widely spreading of CAE such as go through the Southern of Thailand from the source in the Central of Thailand.

CONCLUSIONS AND RECOMMENDATION

Conclusions

Herd seroprevalence of CAE in meat goats in Chainat province was 11.51%. Risk factors associated with seroprevalence at herd level were time raising (years) of farmer, herd size usually raising at 80 goats. Farm that has history of mastitis within farm in range 1 year tend to seroprevalence of CAE. Tested CAE in new goat before move into the farm has low risk than not test. The test before bring imported goats into farm is an important factor necessary to prevent the introduction of CAEV into destination farm.

Suggestions from this thesis, data of this analysis were herd level so the individual data properties such as age, sex, breeder, and time that goat lives until interview day were not successfully used in the analysis. But they can be benefit to both farmers and public, regarding the demographic data. Quarantine factor should be added in the quantitative risk assessment to estimates the probability of introduction level of CAEV into farm via imported goats if quarantined.

Recommendations

Risk factors for CAE infection at farm levels are longer experience of the farmers, larger farms. Mastitis can be an indicator to check for CAEV. Testing the disease before letting the animals to commingle with the animals in the farms are important since it can reduce almost 2 times of the risk. Not good sanitation quarantine station can be the factor of disease spreading. This thesis result and conclusions presented here will be useful in helping Thailand to develop policies to prevent and control the risk for CAEV within the country.

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APPENDICES

Appendix A
Questionnaires A

Questionnaires has objective for Veterinary Epidemiology, Master Degree Thesis during 2009 to 2010.

Faculty of Veterinary Medicine, Kasetsart University

1. General Data

1.1 Name……Surname……Age……years
Address……Moo……Subdistrict……District……
Province……Post code……Tel……

1.2 Main career……
Office address……Moo……Subdistrict……District……
Province……Post code……Tel……

1.3 Additional career……
Office address……Moo……Subdistrict……District……
Province……Post code……Tel……

1.4 Raising goats since Date……Month……Year…… Total……goats
Or raising goat farm for……Months (if more than 11 months)……years

1.5 Place of goat house □ at home □ other……

1.6 Education
□ Not schooling □ Primary □ High school
□ Certificated □ Bachelor □ Other degree

1.7 Religious
□ Buddhist □ Christian □ Muslim

1.8 Other animal excluding goat
□ …….dogs □ ……cows □ ……buffaloes
□ ……sheep □ ……cats □ ……pigs
□ other explain…… □ None

2. Farm management

2.1 Objective of the farm
□ finishing □ selling of bucks and does for breeding
□ breeding and selling by weight □ middle man
□ quarantine place □ other explain……

2.2 Total of goats.....goats

2.2.1 male.....goats
□ age>6 months.....goats □ age<6 months..... goats
2.2.2 female.....goats
□ age>6 months.....goats □ age<6 months..... goats

2.3 Number of goat houses.....houses
size.....metre square (.....houses) .....goats/house calculate to .....goats/metre sq.
size.....metre square (.....houses) .....goats/house calculate to .....goats/metre sq.
size.....metre square (.....houses) .....goats/house calculate to .....goats/metre sq.

2.4 Floor of the house
□ soil □ wooden height.....metres □ cement height.....metres
2.5 Having of pen for does' parturition or nursery pen □ Yes □ No

2.5 Grazing or indoor feeding
□ Only indoor □ Free grazing
□ Grazing on the day, back in the end of the day
□ Other explain.....

2.6 Time of grazing in the grassfields.....hours/day
Within the range of .....am to .....am and .....pm to.....pm
Other explain.....

□ myself grass field ( ) joined with other goat herd
( ) joined with other cow/buffaloes/sheep herd
( ) not joined
( ) has water source ( ) no water source
Description..... .....
.....
.....

□ public grass field ( ) joined with other goat herd
( ) joined with other cow/buffaloes/sheep herd
( ) not joined
( ) has water source ( ) no water source
Description.....
.....
.....
.....

□ other grass field ( ) joined with other goat herd

( ) joined with other cow/buffaloes/sheep herd
( ) not joined
( ) has water source ( ) no water source

Description.....

.....

.....

.....

2.7 water source

□ river/canel ( ) joined with other goat herd
( ) joined with other cow/buffaloes/sheep herd
( ) not joined

Description.....

.....

.....

.....

□ public pool ( ) joined with other goat herd
( ) joined with other cow/buffaloes/sheep herd
( ) not joined

Description.....

.....

.....

.....

□ own pool ( ) joined with other goat herd
( ) joined with other cow/buffaloes/sheep herd
( ) not joined

Description.....

.....

.....

.....

□ other identify ( ) joined with other goat herd
( ) joined with other cow/buffaloes/sheep herd
( ) not joined

Description.....

.....

.....

.....

3. Farm management

3.1 Quarantine new goat □ Yes for**.....**days □ No

3.2 History of health status of new goats which coming to the farm
□ Test for the disease**.....**total**.....**time by (who/where)**.....**
□ Not test
□ Unknown

3.3 Frequency of test disease within farm

	time/year	Laboratories result within one last year		
3.3.1 Brucellosis	……	( ) positive	( ) negative	( ) other.....
3.3.2 CAE	……	( ) positive	( ) negative	( ) other.....
3.3.3 FMD	……	( ) positive	( ) negative	( ) other.....
3.3.4 Worm and protozoa	……	( ) positive	( ) negative	( ) other.....
3.3.5 Other identify	……	( ) positive	( ) negative	( ) other**.....**

3.4 Breeding
□ Natural breeding □ Artificial insemination by**.....**
□ Embryo transfer by**.....**

3.5 Buck
□ own male:female ratio equal**.....**
□ exchange buck male:female ratio equal**.....**time/year
Duration of staying with farm**.....**
□ other
identify**.....** **.....**

3.6 Newborn feeding
□ by its does
□ separate kid and pooled colostrums □ boiled □ not boiled
□ separate kid and individual colostrums □ boiled □ not boiled
□ other explain**.....** **.....**

3.7 Milk bottle using
□ Joined many kids together □ Not joined
□ Disinfectant or cleaned □ No disinfectant or cleaned

3.8 Pre-weaning feeding
□ by its does
□ separate kid and pooled colostrums □ boiled □ not boiled
□ separate kid and individual colostrums □ boiled □ not boiled
□ other explain**.....**
3.9 Deworming in farm

□ Never □ Monthly □ every 3 months □ every 6 months
□ Once a year □ other explain.....

3.10 Equipment in the farm
□ Owned (disinfect/not disinfect) □ The other's (disinfect/not disinfect)

3.11 Ear tag equipment disinfectant or cleaned
□ Yes □ No
□ other explain.....

3.12 Needle use
□ Multiple uses □ Single use
□ Disinfectant or cleaned □ Not disinfectant or cleaned

3.13 Frequency of sweeping feces both on and under the goat house
□ Never □ Daily □ 1-2 times/week □ other identify.....

3.14 Frequency of using disinfectant to clean the goat house
□ Never □ Daily □ 1-2 times/week □ other identify.....

4. Sick goat management

4.1 History of clinical sign in goats within last year (answer can be more than one answer)
□ lameness □ swelling of limbs' joint □ dyspnea
□ mastitis □ seizure □ fever
□ recumbency by parelysis □ other identify.....

4.2 Separation of sick goats from herd or sicked goat pen
□ Yes □ No

4.3 Treatment
□ Yes by ( ) (who)..... ( ) myself
( ) cost .....baht/time
( ) no cost
□ No treatment

4.4 Eradication of sick goats
□ No eradication □ Slaughter house □ Consumed □ Bury or burn
□ Sale to (name-last name).....Tel.....

.....Thank you for our cooperation.....

Appendix B
Questionnaires B

Questionnaires for quantitative risk assessment of caprine arthritis encephalitis in goat in Chainat

Introduction

This questionnaire is a part of data collection and data analysis for thesis of MissPattarin Opaschaitat master degree student, student code 5224900034, Veterinary epidemiology branch, Kasetsart University, the second year. Topic of thesis is prevalence, risk factors, and quantitative risk assessment (introduction level) of caprine arthritis encephalitis; CAE into meat goat farm via imported goat, Chainat province, during October 2009 to October 2010. At first, interview goat farmers, sera collection to test for CAE infection. Univariate logistic regression and multivariate logistic regression to estimate the herd seroprevalence and risk factors, result showed time raising (year), herd size (divide by usually number of goats/farm). But they are not involving the introduction factor of bringing imported goat into farm to put in the model of quantitative risk assessment. So it had to ask the expert opinion for the data, which requirement of be an expert are including; a veterinarian, at least 5 years of experience in the goat field, and had at least one paper published about goat. The questionnaires totally are 6 questions in 3 pages, which your answers will keep in secret. Any question from you, please contact me at tel. 0-81291-5480.

Thank you very much
Pattarin Opaschaitat

Section 1 general data of the expert

1. Name-Last name.....
2. Job description.....
3. Address (Office).....
4. Address (Connectable).....
5. Tel. (office).....Mobile phone……..
6. e-mail address.....

Section 2 the questions

1. How confident are you in your knowledge and understanding of CAE in Chainat provience? (1=minimum, 2=medium, 3=maximum)

answer

2. In your opinion, what is the minimum, most likely, and maximum number of goats imported into Thailand per farm, per year? How confident are you in your answer? (1 = not sure, 2 = sure, 3 = very sure)

answer

minimum (goats/farm/year)	most likely (goats/farm/year)	maximum (goats/farm/year)	Confident level

3. In your opinion what is the probability (in percent) that imported goats no t tested will introduce CAE into their designated farm. How confident are you in your answer? (1 = not sure, 2 = sure, 3 = very sure)

answer

minimum (%)	maximum (%)	Confident level

4. In your opinion what is the probability (in percent) that samples mislabeled in the field have lead to seropositive animals not being culled from the herd. How confident are you in your answer? (1 = not sure, 2 = sure, 3 = very sure)

answer

minimum (%)	maximum (%)	Confident level

5. In your opinion what is the probability (in percent) that samples mislabeled in the laboratory have lead to seropositive animals not being culled from the herd. How confident are you in your answer? (1 = not sure, 2 = sure, 3 = very sure)

answer

minimum (%)	maximum (%)	Confident level

6. In your opinion what is the probability (in percent) that due to transport time, variance in temperature and improper storage of samples can cause false results. How confident are you in your answer? (1 = not sure, 2 = sure, 3 = very sure)

answer

minimum (%)	maximum (%)	Confident level

Thank you very much
Pattarin Opaschaitat

CURRICULUM VITAE

NAME : Ms. Pattarin Opaschaitat

BIRTH DATE : September 29, 1981

BIRTH PLACE : Bangkok, Thailand

EDUCATION :

YEAR	**INSTITUTE**	**DEGREE/DIPLOMA**
2006	Kasetsart Univ.	D.V.M.

POSITION/TITLE : Veterinary officer

WORK PLACE : National Institute of Animal Health

SCHOLARSHIP/AWARDS : **-**