



**UNIVERSITI PUTRA MALAYSIA**

**STUDIES ON THE PATHOGENESIS OF CONTAGIOUS  
ECTHYMA IN GOATS AND SHEEP**

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**STUDIES ON THE PATHOGENESIS OF CONTAGIOUS ECTHYMA  
IN GOATS AND SHEEP**

By

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A Thesis Submitted in Fulfilment of the Requirements for  
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**KAJIAN KE ATAS PATOGENESIS PENYAKIT EKTIMA MENULAR  
DI DALAM KAMBING DAN BEBIRI**

Oleh

**ROSHIDAH BINTI ISMAIL**

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Virus penyakit ektima menular tempatan yang diasingkan daripada kambing dan bebiri digunakan dalam beberapa siri eksperimen ke atas kambing dan bebiri untuk membandingkan corak perkembangan penyakit, kevirulenan virus dan ketahanan hos.

Virus ektima menular kaprin (GV 1) boleh menjangkiti kambing dan bebiri, menghasilkan lesi tipikal. Penginokulatan kali kedua ke atas haiwan yang sama menghasilkan lesi yang cepat sembuh daripada lesi pertama. Perubahan matakasar dan histopatologi yang dihasilkan dalam jangkitan pertama dan kedua adalah sama walaupun lesi dalam jangkitan pertama adalah lebih teruk. Walau bagaimanapun, penginokulatan kali ketiga ke atas haiwan yang sama gagal untuk menghasilkan sebarang lesi.

Jangkitan oleh bakteria sekunder ke atas lesi penyakit ektima menular menurunkan berat badan dan kadang-kala menyebabkan kematian. Penginokulatan



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## LIST OF ABBREVIATIONS

ABTS	-	2,2'- azino- bis(3-ethylbenzthiazoline - 6- sulfonic acid)
cfu	-	colony forming unit
cm	-	centimeter
cm <sup>2</sup>	-	centimeter square
<i>C. pyogenes</i>	-	<i>Corynebacterium pyogenes</i>
ELISA	-	Enzyme Linked Immunoabsorbent Assay
FAT	-	Flourescence Antibody Test
g	-	gram
G	-	gauge
IPS	-	Immunoperoxidase Staining
kg	-	kilogram
l	-	litre
M	-	Molar
mg	-	miligram
ml	-	mililitre
mm	-	milimeter
mM	-	milimolar
nm	-	nanometer
PBS	-	Phosphate Buffered Saline
PBS-T	-	Phosphate Buffered Saline - Tween
SDS	-	Sodium Dodecyl Sulphate
TRIS	-	Hydroxymethyl methylamine
μg	-	microgram



$\mu\text{l}$	-	microlitre
%	-	per cent
>	-	more than
<	-	less than

Abstract of thesis submitted to the Senate of Universiti Pertanian Malaysia in fulfilment of the requirements for the degree of Master of Science.

**STUDIES ON THE PATHOGENESIS OF CONTAGIOUS ECTHYMA  
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Local contagious ecthyma viruses isolated from sheep (Lb) and goats (GV 1 and GV 2) were used in a series of infection trials in kids and lambs to compare the pathogenesis, virus virulence and host susceptibility.

Caprine contagious ecthyma isolate (GV 1) was able to establish infection in kids and lambs, producing typical lesions. When rechallenged, the infected kids and lambs developed rapid but milder lesions followed by rapid resolution. The clinical and histopathological changes in the primary and secondary infections were similar but were more severe in the former. The third infection, however, failed to establish any lesions.

Secondary bacterial infection appeared to have complicated the contagious ecthyma lesions resulting in a marked reduction in body weight and occasional death. The inoculation of *Corynebacterium pyogenes* into the contagious ecthyma lesions resulted in much more severe lesions resembling those observed in field cases





of complicated contagious ecthyma. This finding suggests that in natural cases, contagious ecthyma virus probably acts synergistically with other agents to produce severe and generalised lesions.

Although the kids and lambs appeared to have similar disease, the kids developed more severe lesions. Severity of the lesions produced were compared statistically between the viral isolates and between the animal species. The caprine GV 2 isolate was found to produce lesions in both kids and lambs with similar severity whereas the ovine isolate (Lb) produced milder lesions in lambs but severe lesions in kids. These observations correlated well with the development of antibody response. In general, the lambs showed better antibody response than the kids, reaching significantly high level on day twenty-two, coinciding with recovery from the disease. The kids infected with Lb virus responded poorly leading to the severe disease and longer recovery period.



bakteria *Corynebacterium pyogenes* ke dalam lesi ektima menular menghasilkan lesi teruk yang menyerupai lesi semulajadi ektima menular berkomplikasi. Kajian ini mencadangkan bahawa dalam keadaan semulajadi, virus ektima menular mungkin bekerjasama dengan agen-agen lain dalam menghasilkan lesi penyakit ektima menular yang lebih teruk.

Walaupun kambing dan bebiri berupaya menghasilkan corak penyakit yang sama setelah diinokulat dengan virus penyakit ektima menular, kajian menunjukkan bahawa kambing adalah spesis yang akan menghasilkan lesi yang lebih teruk dibandingkan dengan bebiri. Isolat kambing GV 2 menghasilkan lesi yang sama darjah keterukannya ke atas kambing dan bebiri manakala isolat bebiri Lb menghasilkan lesi yang kurang teruk ke atas bebiri berbanding dengan lesi pada kambing. Ini berkaitan rapat dengan corak perkembangan antibodi. Secara umum, perkembangan antibodi adalah lebih baik dalam bebiri daripada kambing, dan boleh mencapai tahap tinggi dalam masa dua puluh dua hari, iaitu bersamaan dengan masa sembuh. Kambing yang dijangkiti isolat bebiri Lb amat kurang menunjukkan gerakbalas antibodi sehingga menghasilkan lesi yang teruk dan tempoh sembuh yang lama.

## CHAPTER 1

### INTRODUCTION

In Malaysia, contagious ecthyma is known to be a common disease of sheep and goats (Peters et al., 1979). The disease is caused by a parapoxvirus, and is believed to be more severe in goats than in sheep. Goats of all ages are known to be susceptible to the infection although many adult animals are less likely to be infected due to immunity as a result of an earlier infection (Reid, 1991).

The disease is characterised by the formation of vesicular and scabby lesions on the lips which usually develop following minor damage to the skin caused by dry and prickly pasture (McKeever et al., 1988). Following the infection, progressive epidermal lesions develop, beginning from the formation of macule, papule, vesicle, pustule to scab formation.

The incidence of the disease in different flocks is extremely variable; it may attack all members of a flock irrespective of age, it may affect most or all of the young, or it may affect only a few animals in the flock.

Infection with a highly contagious parapoxvirus results in considerable losses. In 1976, the disease was rated as a top health priority problem by the United State Sheep Industry Development Programme (Morison, 1976). It is an important disease of economic significance to the animal industry; in severe and moderately severe cases it causes marked loss of body condition particularly in the



feedlots due to the difficulty or inability of the affected animals to suckle or prehend food due to the deformation of the lips. If the lesions become secondarily infected with screw-worms, bacteria or parasites, it may contribute to the death of the affected animals as high as 50 % (Robinson and Balassu, 1981).

Outbreaks of contagious ecthyma have been reported in Peninsular Malaysia especially in the states of Perak, Kedah, Pahang and Johor. The first reported outbreak was in 1935, and since then several cases were reported to occurred until 1960 (Asiah, 1990). No further studies on contagious ecthyma in Malaysia were carried out following these reported outbreaks until recently when a study was conducted by Zamri-Saad et al., (1989). The lack of detailed studies on contagious ecthyma in Malaysia could be due to the benign nature of the disease and the familiarity with the infection. These lead to those involved with sheep and goat rearing opting not to seek professional advice while those involved with research unaware of the importance of this disease (Peters et al., 1979).

Studies on the disease have been carried out in sheep and goats overseas, mostly using the viruses isolated from the same animal species. Reports of experimental cross-infection such as infection in sheep using isolates from goats are less common although a considerable heterogeneity based on the restriction endonuclease analysis was observed between the different isolates of contagious ecthyma virus (Robinson et al., 1982; Rafii and Burder, 1985).

The aims of these studies are:

- 1) to determine the pathogenesis of complicated and uncomplicated contagious ecthyma in sheep and goats.
- 2) to determine the differences in virulence between caprine and ovine isolates on contagious ecthyma virus and the differences in susceptibility to the infection between sheep and goat hosts.

## CHAPTER 2

### LITERATURE REVIEW

Livestock is an important and integral component of the agricultural sector. The Malaysian livestock industry can be classified into the ruminant and the non-ruminant sub-sectors. Cattle, buffalo, goat and sheep constitute the ruminant sub-sectors. In Malaysia, most goats and sheep belong to smallholders who keep the animals in small flocks (Peters et al., 1979).

There are about 288,516 and 234,901 heads of goats and sheep in Malaysia respectively (Zamri-Saad et al., 1990). The goat population is made up of mostly the indigenous kambing kacang, several exotic purebreds and the resulting crossbreds. The sheep population is also made up of the indigenous breed Malin (from the words Malaysian indigenous), exotic purebreds and the resulting crossbreds. The overall development of the sheep and goat industry in this country is not very encouraging although the sheep industry has been targeted to be one of the most prominent ruminant subsector in Malaysia in the next century (Babjee, 1988).

One of the constraints for rapid development of ruminant industry in Malaysia is their small population that is widely distributed in small groups (Babjee, 1988). Furthermore, the rearing system which minimises planned breeding and the fact that rearing ruminants is only a subsidiary activity of most smallholder farmers contributed significantly to the slow growth of this sub-sector (Peters et al., 1979; Babjee, 1988). Thus, two approaches have been considered to improve the industry.

The first approach is to select suitable local animals to be crossbred with improved temperate breeds. The second approach is to import productive temperate or 'tailor-made' breed deemed adaptable to the Malaysian environment (Babjee, 1988). Both approaches have been carried out on sheep to improve the industry and with this, many more diseases such as contagious ecthyma will be encountered.

Contagious ecthyma has been reported as one of the most common diseases of sheep and goats in Malaysia (Peters et al., 1979; Babjee, 1980) although currently there are very few published data on the incidence of the disease. A review of the literature shows that the disease occurs in many parts of the world including Malaysia and there were several reports describing this condition (Zamri-Saad et al., 1989; Martin and Aitken, 1991).

### **History of Contagious Ecthyma**

Contagious ecthyma was first described by Walley (1890) who referred the disease as orf. Later, Glover (1928) reported an extensive investigation of the disease in England using the name contagious pustular dermatitis. Howarth (1929) in California and Schmidt and Hardy (1932) in Texas, described the disease as sore mouth, which they consider identical with the condition reported earlier by Glover (1928). The term contagious ecthyma was first used by Moussu (1923) who described the lesions on the lips. He refused the use of the term stomatitis because the lesions were often confined to the skin of the lips without involving the epithelium of the mouth. At the same time in France, Aynaud (1923) described the same condition as contagious pustular stomatitis.

In Western Texas, the disease was observed to occur during the spring and summer months as a mild form among short-yearling lambs (Boughton and Hardy,

1934). The disease had earlier been reported in Greece (Blanc et al., 1922), Colorado (Newsom and Cross, 1934) and South Africa (Theiler, 1928).

In Malaysia, the disease was first reported in 1935 in a herd of Government goats kept at Raub, Pahang (Babjee, 1980). The term ecthyma contagiosum was used to describe the disease (Asiah, 1990). The disease was again reported in 1938 and since then the disease was noted to be of common occurrence in goats and was encountered in practically every state.

### **Contagious Ecthyma in Malaysia**

In 1937, detailed observations of contagious ecthyma were made by the Veterinary Officer of Perak, Mr. W. Orr. He reported a high incidence of the disease in northern part of Perak. A severe case of ecthyma contagiosum occurred in a young experimental goat from which the description of the disease in Malaysia from its commencement to a fatal termination was made (Asiah, 1990).

Further detailed observations were made in 1938, where experiments were undertaken to confirm the pathological identity of contagious ecthyma, to ascertain the susceptibility of local goats to reinfection, to determine the susceptibility of sheep to artificial infection and the possibility of transmitting infection artificially through a series of goats.

In a recent study in Malaysia, Zamri-Saad et al., (1989) monitored 15 smallholder goat farms for naturally occurring caprine contagious ecthyma in the local kacang goats. A total of 260 goats were confirmed to suffer from contagious ecthyma and did not succumb again to the disease within a period of one year following the infection. Another study described the oral lesions of contagious

ecthyma following several outbreaks in farms which had a persistent problem of contagious ecthyma (Zamri-Saad et al., 1992).

### **Aetiological Agent**

Contagious ecthyma virus is a member of the genus parapoxvirus in the family of Poxviridae. According to Mathews (1982), the genus consists of contagious ecthyma virus, bovine papular stomatitis virus and pseudocowpox virus with which it shares at least one common antigen (Papadopoulos et al., 1968).

The virus of contagious ecthyma resembles the viruses of sheep pox and goat pox (Bennet et al., 1944, Sharma and Bhatia, 1959). The virus particle is smaller than other pox viruses and appeared as a monomorphic short rod with rounded ends. The most striking morphological feature is a crisscross pattern produced by 8-10  $\mu$  wide tubular threads (Nagington et al., 1964).

The virus is relatively thermostable and resistant to dessication. It is completely inactivated at 60°C for thirty minutes but retains some infectivity when held at 55°C for thirty minutes (Sawhney, 1972; Buxton and Fraser, 1977).

Mazur and Machado (1989), claimed that the virus had been poorly studied throughout the world and noted that the virus was low in pathogenicity in herds which were kept extensively but extremely pathogenic in closed herds.

### **Age Susceptibility**

Sheep and goats of all ages were susceptible. However the incidence is usually high in young animals particularly within a few weeks of birth. In a study by Zamri-Saad et al. (1989), out of 260 goats examined, 54 % were kids of less than three months old and the youngest affected kids were twenty-two days old.





Experiments by Boughton and Hardy (1934) demonstrated that aged sheep and goats remained susceptible if they had not undergone a previous attack of the disease during their early life. If the animals has been exposed to the infection, they will develop an immunity that protects them from the reinfection for a period of about as long as eight months. Moreover older animals seldom show the severe type of infection which is the typical form encountered in lambs and kids.

### **Species Susceptibility**

It had been noted that local and crossbred sheep showed less severe lesions compared to goats but imported sheep tended to show much more severe lesions than local sheep (Zamri-Saad et al., 1989). Though the degree of severity was comparable between goats and sheep, the disease was identical within each species (Blanc et al., 1922).

The disease has been observed to be able to transmit to cattle, dog and man (Leavell et al., 1968; Erickson et al., 1975; Kim and TARRIER, 1977; Wilkinson, 1977; Guss, 1980; Robinson and Balassu, 1981; Philip, 1983). In man, the lesions usually develop after accidental inoculation from infected animals or contaminated objects. Direct human to human infection has not been reported (Wilkinson, 1977). Generally, the infections in man are benign and appear to be clinically identical with those of contagious ecthyma of sheep and goats.

No characteristic lesions were observed in experimentally inoculated rabbits, mice, chickens and chick embryos (Sinha et al., 1986). In a similar attempt, Aynaud (1923), Greing (1956) and Plowright et al. (1959) also failed to cultivate the virus in such animals and birds. However, Abdussalam (1957) succeeded in the cultivation of contagious ecthyma virus in rabbits but failed to grow the rabbit-adapted virus in