UNIVERSITI PUTRA MALAYSIA

GASTROINTESTINAL PARASITISM IN GOATS - BIONOMICS OF THE SUPRAPOPULATION AND INCIDENCE IN YOUNG GOATS

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By

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PREFACE

This thesis comprises two parts. Part 1 describes the testing and further modification of the Modified Parfitt's Technique (MPT) which is used to recover and enumerate infective larvae from herbage. An assessment of the concentration of infective nematode larvae on pasture herbage gives an indication of the infection to which grazing animals are exposed. The technique was then tested under field conditions to study the survival of infective trichostrongyle larvae. An experiment aimed at determining the rates of development of the various preparasitic stages is also included. Part 2 is a study on the incidence and significance of gastrointestinal parasites in goats from birth to nineteen months old.

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The Modified Parfitt's Technique (MPT) is used to assess the concentration of infective nematode larvae on pasture which gives an indication of the infection to which grazing animals are exposed. Validation of this technique showed that it was not successful when applied in the field and variation in results occurred among different grass species. Using *Panicum maximum* (Guinea), *Setaria sphacelata* var splendida (Setaria) and *Digitaria setivalva* (Mardi Digit) grasses, modifications were introduced to improve the larval recovery rate. The soaking of herbage in lukewarm water (38^{o}C) instead of tap water increased the recovery rate significantly without variation between the three grasses tested.

Using this improved MPT, plot trials were conducted to assess the longevity of third-stage larvae (L3) of goat trichostrongyles under the forementioned grass leys. However the technique failed to recover any L3. Reasons for this were low number of larvae, rainfall, and larval-grass/debris adherence. There is a need for further investigation into this technique.

Studies were also conducted to establish the moulting times of the pre-parasitic stages of *H.contortus* under the three grass leys. Development to L1 and L2 took the same time under the various grasses. Development time to L3, however, was longest under Mardi Digit followed by Setaria and Guinea. The lower temperatures under Guinea aided a more rapid development compared to the other grass species.

In order to establish the incidence and significance of gastrointestinal parasitism among kids, faecal samples and liveweights were obtained weekly for seventy-nine weeks from forty-six newly born kids kept under a semi-intensive management. Strongyle infections were detected from two months of age and coccidia from one month. The strongyles were identified as *Haemonchus* and *Trichostrongylus* species. Infection with strongyles and coccidia was continuous throughout the study period. Patent infections with *Moniezia*

occurred at eleven weeks of age and continued until thirty-eight weeks of age.

Comparisons of egg/oocyst output and liveweight gain (LWG) of animals that survived and those that eventually died showed a significant difference in egg output and LWG but not in oocyst output. The prevalence of parasites was moderate in kids below three months of age and high among those above three months. The possibility of reduced average daily gain (ADG) due to parasites was evident and the combined effects of *H.contortus* and *T.colubriformis* significantly increased mortality rate among the animals.

Egg and worm counts were positively correlated except for *T.colubriformis* counts among animals above six months of age. The use of the "total pathogenic index" (TPI) as a diagnostic measure is of valuable significance. Correlation analysis showed suppression of eggs and oocyst production after twelve and six months of age respectively, suggesting acquisition of immunity.

Abstrak tesis yang dikemukakan kepada Senat Universiti Pertanian Malaysia bagi memenuhi syarat-syarat ijazah Master Sains.

PARASITISME GASTROUSUS PADA KAMBING - BIONOMIK SUPRAPOPULASI DAN INSIDENS PADA KAMBING MUDA

Oleh

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NOVEMBER 1991

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Teknik Modified Parfitt's (TMP) didapati tidak berjaya mencapai matlamatnya apabila digunakan di ladang dan terdapat perbezaan dalam keputusan apabila spesies rumput yang berlainan digunakan.

Pengubahsuaian ke atas teknik ini dengan menggunakan spesies-spesies rumput *Panicum maximum* (Guinea), *Setaria sphacelata* var splendida (Setaria) dan *Digitaria setivalva* (Mardi Digit) menunjukkan peningkatan peratus perolehan yang bermakna tanpa perbezaan di antara ketiga-tiga spesies rumput telah tercapai dengan merendam rumput di dalam air suam ($38^{o}C$).

Ujikaji-ujikaji plot dengan menggunakan TMP yang diubahsuai, gagal mengesan larva daripada rumput. Di antara

sebab-sebab kegagalan ini adalah bilangan larva pada rumput yang terlalu sedikit, hujan yang lebat dan kesukaran memisahkan larva daripada rumput.

Kajian untuk menentukan jangkamasa perkembangan peringkat-peringkat pra-parasitik cacing *H.contortus* di bawah rumput-rumput pastura menunjukkan peringkat L1 dan L2 mengambil masa yang sama di bawah rumput-rumput tersebut. Perkembangan kepada L3 mengambil masa paling lama di bawah Mardi Digit diikuti dengan Setaria dan Guinea. Suhu persekitaran yang lebih rendah di bawah rumput Guinea membantu mempercepatkan perkembangan.

Dalam kajian insidens dan kepentingan parasitisma gastrousus pada anak-anak kambing, infeksi-infeksi strongil dikesan sejak umur dua bulan dan koksidia sejak satu bulan. Strongil-strongil dikenalpasti sebagai spesies *Haemonchus* dan *Trichostrongylus*. Infeksi dengan strongil dan koksidia berlarutan sehingga tamat tempoh ujikaji. Infeksi-infeksi paten dengan *Moniezia* dikesan pada umur sebelas minggu dan berterusan sehingga umur tiga puluh lapan minggu.

Perbandingan hasilan telur cacing dan peningkatan berat badan antara haiwan-haiwan yang hidup dengan yang telah mati dalam tempoh ujikaji menunjukkan perbezaan yang bermakna. Tidak terdapat perbezaan di antara kedua-dua kumpulan haiwan ini dari segi hasilan oosista koksidia.

Prevalens parasit sederhana pada anak-anak kambing di bawah umur tiga bulan dan tinggi selepas umur ini. Kemungkinan berkurangnya purata pertambahan berat harian disebabkan kesan parasit telah ditunjukkan dan kombinasi kesan-kesan *H.contortus* dan *T.colubriformis* mengakibatkan kadar kematian yang bermakna.

Kiraan telur pada tinja dan bilangan cacing pada saluran gastrousus telah menunjukkan korelasi positif. Bagaimanapun bagi *T.colubriformis*, tidak terdapat korelasi di antara kedua-dua pembolehubah ini bagi haiwan-haiwan yang berumur lebih daripada enam bulan. Penggunaan "indeks jumlah patogenik" (IJP) sebagai ukuran diagnosis didapati amat berkesan. Analisa korelasi juga telah menunjukkan pengurangan penghasilan telur cacing dan oosista koksidia dalam tinja kambing-kambing masing-masing selepas mencapai umur dua belas dan enam bulan. Ini menandakan kehadiran pelalian perolehan.

PART 1

BIONOMICS OF THE FREE-LIVING STAGES OF GOAT TRICHOSTRONGYLES

CHAPTER I

INTRODUCTION

The Malaysian small ruminant industry is suffering losses due to trichostrongylid infections, mainly haemonchosis. One of the main options of controlling trichostrongylosis is grazing management since pastures on which animals graze are considered as a centre for the dispersal and exchange between sheep and parasite populations (Crofton, 1971). For this, the bionomics, that is factors affecting the development and survival of the suprapopulation (free-living population) of trichostrongyles has to be known.

There is virtually no study reported on the bionomics of trichostrongyles in the humid tropics. The findings in other climatic regions cannot be applied to the humid tropics. Hence this part of the study was devoted to the bionomics of free-living stages of trichostrongyles.

The first objective was to assess a widely acceptable technique, the Modified Parfitt's Technique, used for the recovery of third stage trichostrongyle larvae from herbage. Modifications, where found necessary, were applied to the initial technique. The second objective was to apply this technique to field conditions to estimate the survival time of goat trichostrongyle larvae under three different grass

leys. The third objective was to determine the hatching and moulting times of *Haemonchus contortus* eggs under these grasses.

CHAPTER II

LITERATURE REVIEW

Technical Aspects in the Recovery of Infective Nematode Larvae from Herbage

General

The estimation of larval populations of trichstrongyles on pasture has become a common means of monitoring the risk of infection in Europe (Cabaret *et al.*, 1986). Various methods for the recovery, differentiation and enumeration of infective larval stages found on herbage have been described (Taylor, 1939; Crofton, 1954; Donald, 1967; Heath and Major, 1968; Bawden, 1969; Heath *et al.*, 1970; Lancaster, 1970; Smeal and Hendy, 1972; Armour, 1982; Lee and Ikeme, 1985; Gettinby *et al.*, 1985; Cabaret *et al.*, 1986).

According to Gettinby *et al.* (1985), there are three currently used methods to assess the concentration of infective larvae of parasitic nematodes on pasture. The first methdod describes a technique by which recovery, enumeration and identification of infective larvae could be achieved by manual sampling of herbage (Taylor, 1939). Another method is the grazing method using either animals free of parasites (Tetley, 1959) or rendered free by the use of anthelmintics (Anderson, 1973; Armour, 1982). These animals, usually referred to as "tracers" are slaughtered soon after completion of grazing and

their worm burdens analysed. The third method, described by Heath *et al*. (1970) uses oesophageal fistulated animals to collect herbage samples.

Bawden (1969) was able to obtain a mean recovery of 90.4% with his apparatus. However as stated by Smeal and Hendy (1972), the cost of the sieve and filtering apparatus would prohibit its constant use. Parfitt (1955) reported that when a known number of larvae was placed on grass, his technique yielded an average of 43%. Durie (1959) tested his technique by adding known numbers of larvae to sediment obtained by washing samples of pasture which were free of infective larvae. Recoveries ranged from 61% to 94% with an average of 74%.

Gettinby *et al*. (1985) observed a three to nine fold increase in recovery rates from oesophageal fistulated animals compared to manual sampling. However Cabaret *et al*. (1986) observed that ewes ingested on average less infected herbage than would be predicted from a random sample collected on pasture.

It is acceptable that throughout the labourious, time consuming process of separating larvae and subsequent enumeration, there will be a considerable loss of larvae. However these losses can be minimized by modification of the current techniques. In general the techniques employed in the

recovery of infective nematode larvae combine four major aspects:

* Sampling of the herbage
* Separating the larvae from the herbage
* Separating the larvae from the debris
* Microscopical examination of the larvae

Herbage Sampling

The first and most important aspect in recovering infective nematode larvae is the sampling of the herbage. The method employed should be able to pick up as many infective larvae as possible. Various methods of sampling herbage have been described. Taylor (1939) preferred a double zigzag ("W") fashion and collections made at about one hundred different places by pinching two or three pinches of grass from four places at each spot. Plucking should be as close to the ground as possible without uprooting the grass.

Lee and Ikeme (1985) only used a single zigzag and collection made at every fifth step. They preferred cutting the top clusters of herbage in front and on both sides so as to simulate the grazing behaviour of the animals. Smeal and Hendy (1972) preferred to follow Taylor's method. Lancaster (1970) also preferred Taylor's method but stated that "N" shaped transects are more convenient for a single collector. He stated

that there was no apparent difference between results obtained by either method of sampling.

According to Crofton (1954), Taylor's method, in theory, was inefficient due to the low number of traverses. He claimed that only if larvae were numerous and randomly distributed would Taylor's method be sufficient. However, larvae are neither numerous nor randomly distributed in relation to the total number of pinches. Therefore, it seems obvious that the samples must be either greatly increased in number or size, which in either case increases bulk and makes the recovery more difficult (Crofton, 1954).

The various methods for the recovery of infective larvae have been subjected to various tests in order to validate the technique. However, most of the workers (Donald, 1967; Heath and Major, 1968; Bawden, 1969; Lancaster, 1970; Smeal and Hendy, 1972; Lee, 1985) based their results on "spiked" herbage (herbage to which larvae have been added after sampling) and not with natural populations. They did not take into account the effect of grass characteristics upon recovery rates.

Bawden (1969) was able to obtain a high recovery rate with his apparatus but again, his results were based on "spiked" herbage and he failed to mention an appropriate herbage sampling method. Therefore, it is expected that his technique

would give a low recovery rate if the herbage contained natural populations of larvae. This is due to the fact that there is a closer association between natural larval population and debris particles (Lancaster, 1970; Lee, 1985).

Bryan and Kerr (1988) concluded that manual pasture sampling based on observed grazing behaviour seems the only method which meets all criteria. Lee and Ikeme (1985) also noticed the importance of manual sampling and tried to simulate animal grazing habits. Generally it has been accepted that from the single plant, sheep and cattle eat leaf in preference to stem (Arnold and Dudzinski, 1978) and goats tend to nibble at the shoots and leaves of growing plants and reject the stems (Devendra and McLeroy, 1982).

Since ruminants are selective in their grazing habits, the importance of contamination and availability of infective larvae has been recently highlighted. Gettinby *et al.* (1985) claimed that sampling herbage using oesophageal fistulated sheep gave a three to nine fold increase in infective larvae recovery compared to manual collection through a zig-zag route. However, Morley and Donald (1980) stated that the contamination of the pasture with infective larvae may simulate availability after a single shower of rain.

According to Gettinby *et al.* (1985), manual collection of herbage leads to substantial underestimation. Therefore the