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HELMINTH CONTROL FOR SMALL RUMINANTS IN MALAYSIA

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SUMMARY

This paper reviews gastrointestinal helminths present in small ruminants in Malaysia and their pathogenic effects, studies on resistance to anthelmintics and worm control options which include grazing management, anthelmintics, medicated feed blocks, medicinal plants, breeding and biological control.

Keywords: helminth control, small ruminants

INTRODUCTION

Though small ruminant production has been an integral agricultural activity in Malaysia for many years, it is relatively minor compared with other sectors of the livestock industry. Since the mid-1980s, there have been efforts to expand the industry mainly through integration of sheep in the more than four million hectares of oil and rubber plantations (Ibrahim, 1996) in the country.

The 2000-2001 figures from the Department of Veterinary Services, Malaysia estimate the goat and sheep populations to be approximately 235 000 and 131 000, respectively. This review covers work pertaining to control of gastrointestinal parasitism on small ruminants in Malaysia, reported after 1980. The details of some studies are included where it is felt that it would contribute to knowledge in formulating control measures for the disease. Recommendations of some reports considered significant are also included.

ENDOPARASITES OF SMALL RUMINANTS IN MALAYSIA

The endoparasites found in goats and sheep in Malaysia have been previously described by Shanta (1982), Sani *et al.* (1985; 1986), Amin-Babjee *et al.* (1990) and Wahab and Adanan (1993). Common endoparasites include:

- *Haemonchus contortus*
- *Trichostrongylus* spp.
- *Oesophagostomum* spp.
- *Cooperia curticei*
- *Strongyloides papillosus*
- *Paramphistomum* spp.
- *Eurytrema pancreaticum*

Ostertagia spp. and the lungworm *Dictyocaulus* spp. were reported by Shanta (1982) as rare findings and were not found in other studies. Perhaps these parasites were from imported goats and sheep.

EFFECT OF PARASITES ON PRODUCTIVITY

Only one study, by Fadzil in 1977, has attempted to measure the cost-effects of parasitism in small ruminants in Malaysia. Losses (deaths, treatment costs and condemnation in abattoirs) in goats due to parasitism were estimated to be RM44,427 (about USD 11,691). This is considered a gross underestimate because it was extrapolated from a five-year record of the Central Animal Husbandry Station in Kluang, whose records indicate that only one in 937 goats died of parasitism each year. Other more recent studies, which recorded mortality, quote much larger figures (Daud *et al.*, 1991, Symoens *et al.*, 1993).

To assess the natural resistance of goats to parasitism, 46 goats, monitored from birth to 14 months of age, were not given any anthelmintic (Daud *et al.*, 1991). Postmortem examinations revealed that 32% of deaths were due to worms (mean *H.contortus* count 808, *T. colubriformis* 1177) while pasturellosis pneumonia contributed another 30% to deaths. The goats that died of pneumonia also harboured worms (mean *H.contortus* count 236, *T.colubriformis* 203). It was postulated that the worm burden, representing mild haemonchosis, weakened the goats which subsequently succumbed to infection by *Mannheimia* sp., leading to pneumonia. *Mannheimia haemolytica* is part of the normal flora of the nasopharynx of various animals but causes pneumonia when animals are stressed. Zamri-Saad *et al.* (1994) demonstrated that sub-clinical haemonchosis (dosing with 4000-5000 infective larvae), without significant reductions in total serum protein or packed cell volume, stressed goats sufficiently to induce immunosuppression and allow the development of experimentally induced pneumonic pasteurellosis.

In a 15-month study on 13 goat smallholdings in the state of Selangor, the mortality rate for animals up to one year of age was found to be very high at 74% (Symoens *et al.* 1993) while adult mortality was also high at 34%. Pneumonia, mainly caused by *Mannheimia* sp., and haemonchosis were found to be the major causes of deaths in all age classes. The authors recommended improving nutrition to decrease susceptibility of goats to diseases. This may be done by grazing earlier in the day with an increase in the length of grazing time and also advised supplementation especially when the forage diet consisted mainly of grasses. Sam-Mohan *et al.* (1995) noted a mortality of 16% due to clinical haemonchosis in lambs and ewes that grazed on vegetation under oil palm trees.

EPIDEMIOLOGY OF STRONGYLES

There were only a few reports on epidemiology of strongyles in the eighties but in the nineties several studies emerged. The relationship between host factor (age) and rainfall with strongyles was studied (Sani *et al.*, 1985). There was no clear association between age of goats and worm burden for *H.contortus, T.colubriformis* and *O.columbianum*. There was also no correlation between rainfall and parasitism. It was postulated that at all times of the year, grazing goats were ingesting large numbers of infective larvae. This was proven by Ikeme *et al.* (1986) and Cheah and Rajamanickam (1997) who recovered larvae of the three genera on pasture throughout the year. These workers also recovered small numbers of hypobiotic *Haemonchus* larvae from tracer animals indicating hypobiosis do not play an important role in the epidemiology of haemonchosis in Malaysia. Dorny *et al.* (1995) showed that the faecal egg counts (FEC) of sheep and goats were not influenced by the small variation in climate particularly rainfall. A periparturient rise in strongyle egg counts was observed to occur in goats and sheep for about three months starting around parturition (Dorny *et al.*, 1995) while Sam-Mohan *et al.* (1995) observed it in sheep six weeks prior to parturition till eight weeks after. Mean FEC decreased in sheep from 8 months onwards and in goats 12-18 months onwards (Daud *et al.*, 1991, Dorny *et al.*, 1995 and Sam-Mohan *et al.*, 1995).

Bionomics studies of the pre-infective and infective stages on pasture/vegetation found that eggs developed to infective larvae mainly within one week and most larvae survived less than seven weeks (Sam-Mohan *et al.*, 1995, Cheah and Rajamanickam, 1997).

Goats are known to be more susceptible to helminthiasis in compared to sheep but so far there are no reports on the validity of the FEC technique for diagnosing helminthiasis in goats. Therefore the correlation between worm burdens and FEC was examined in local goats (Israf *et al.*, 1996a). FEC prior to natural death and total worm counts of goats that had been submitted for necropsy were performed. Among kids aged below 6 months, there was a significant positive correlation (r=0.9) between FEC and *H.contortus/T.colubriformis* populations. Among kids aged above 6 months, significant positive correlation (r=0.9) existed between FEC and *H.contortus* populations; however, there was no significant correlation (r=0.4) between FEC and *T.colubriformis* burdens. The evidence of positive yet non-significant correlation in the older kids in the case of *T.colubriformis* could be due to insufficient sample size. These findings contributes to the interpretation of FEC in local goats.

In sheep, males are more susceptible to helminth infection in compared to females. To determine whether such a phenomenon occurred in goats the FEC from goat kids from birth to 30 weeks of age was monitored (Israf *et al.*, 1996b). The trend of egg output was similar during the initial 16 weeks of life but from then on, males exhibited a significant increase in egg output. This suggests that young male kids were more susceptible to gastrointestinal nematode infection on the basis of FEC. The practical implication of this finding is that intact males contributes more to infective material compared to their female counterparts.

WORM CONTROL OPTIONS

1. Grazing management

Studies of trichostrongyles on open pasture and on vegetation under tree crops found that eggs developed to infective larvae within a minimum time of 3.5–4 days after faecal deposition and most larvae developed within 7 days. Infective larvae on open pasture survived for 5-6 weeks, on vegetation under rubber trees for 6-7 weeks and on vegetation under oil-palm trees for 5-8 weeks (Sani *et al.*, 1994, Sam-Mohan *et al.*, 1995, Cheah and Rajamanickam, 1997). Earlier it was thought that larvae survived for a much longer period in the micro-environment under the canopy of tree crops (Sani and Rajamanickam, 1990). The relatively short larval survival times observed allows for the integration of grazing management with worm control. Small ruminants can safely graze for 3-4 days in an area which has been 'rested' for 5-6 weeks.

During a 5 month trial, sheep grazing in a rotation system, involving 3–4 days on and 31 days off each paddock, had significantly lower mean egg counts compared to sheep permanently grazing the same pasture and receiving a monthly drench of closantel (Chandrawathani *et al.*, 1995). A 3.5 month study showed that sheep perpetually grazing the same area under mature rubber trees had higher egg counts compared to sheep rotationally grazing in a hedgerow planting system: 3 to 4 days on and 35 days off each area (Sani *et al.*, 1996).

2. Anthelmintics

Commercial products

The control of worms in small ruminants in Malaysia, like elsewhere, relies heavily on the use of anthelmintic drugs. There are a series of reports by Shanta *et al.*, (1978, 1980; 1981a; 1981b) on the use of benzimidazole compounds against gastro-intestinal worms of goat. These trials reported a high level of efficacy (> 90%). However, in the eighties and nineties, other anthelmintics were also used. The use of avermectin derivatives were noted as being highly successful in numerous reports (Sani and Siti-Suri 1989; Rajamanickam *et al.*, 1990; Wahab *et al.*, 1993; Wahab 1997; Chandrawathani *et al.*, 1998a). Closantel was also reported to be effective (Dorny *et al.*, 1994a; Chandrawathani and Adnan, 1995, Chandrawathani *et al.*, 1996a). A postal survey regarding the use of anthelmintics suggested that most government farms used the four major classes of drugs, namely benzimidazoles, levamisole, closantel and ivermectin (Chandrawathani *et al.*, 1994).

Resistance to anthelmintics

Anthelmintic resistance has been suspected in Malaysia since the eighties with unofficial reports of drug failures. In the early nineties, unpublished reports particularly from large semi-government and government farms noted the ineffectiveness of anthelmintics. Dorny *et al.* (1991) in an investigation of the efficacy of currently available anthelmintics in Malaysia in 10 smallholder goat farms, reported suspected benzimidazole resistance of *H. contortus* on two of the farms, using the faecal egg count reduction (FECR) test. A nationwide survey reported the presence of benzimidazole resistance in 33 out of 96 randomly selected smallholder goat farms by means of an egg hatch assay (Dorny *et al.*, 1994b). A correlation was found between drenching frequency in the previous two years and the presence of benzimidazole resistant worms. In the same survey levamisole resistance was detected with an FECR test on two of the ten farms investigated.

Wahab (1994) also reported resistance to benzimidazole by *H. contortus* in 8 out of 10 commercial goat farms in the northern region of the country. Chandrawathani *et al.* (1996b) successfully used a netobimin-levamisole combination drench in goats with a benzimidazole resistant strain of *H.contortus*. However 40 days after treatment, as a result of re-infection, the FEC reached pre-treatment values. Hence, a drug-dependent method of control is only a short-term solution.

Ivermectin and benzimidazole-resistant strains of *H. contortus* were isolated from sheep at an institutional farm that supplied breeding stock to farmers in Malaysia (Sivaraj and Pandey, 1994). Simultaneous resistance of *H. contortus* to benzimidazoles and ivermectin and of *T.colubriformis* to benzimidazoles and levamisole was found in sheep at another institutional farm (Sivaraj *et al.*, 1994). Moxidectin was found to be effective against both worm species present on the particular farm; however, the authors do not recommend using moxidectin when ivermectin resistance is known. Resistance to three anthelmintic classes on the same farm is particularly serious when the farm supplies breeding stock to smallholder farmers, and is hence 'exporting' animals with drug resistant worms.

Chandrawathani *et al.* (1999) investigated 39 sheep and 9 goat farms and showed that the majority had worm populations resistant to all classes of anthelmintics, providing clear evidence that anthelmintic resistance in parasites of small ruminants in Malaysia is rapidly increasing. On a large government farm which served as a sheep breeding centre, anthelmintic resistance increased in three years from being a moderate problem to one where total chemotherapeutic failure had occurred (Chandrawathani *et al.*, 2003).

Medicated feed blocks

Rajamanickam *et al.* (1992) tested an imported commercial anthelmintic feed block in a group of sheep and found relative success in reducing the FEC compared to sheep conventionally drenched, and untreated controls. This is particularly significant as all three groups grazed together and with other sheep that had no access to the block and which were not drenched.

In a study involving sheep grazing under rubber trees, (Sani *et al.*, 1995) animals were given locally made urea molasses block with no anthelmintic, 0.5g/kg fenbendazole, or supplemented with palm kernel cake meal. There was little difference between egg counts of animals receiving fenbendazole and those getting the unmedicated blocks. Even the supplemented animals were able to minimise the establishment of new infections. It is assumed that, provided the larval challenge is 'light', the improved nutrition provided by the blocks, irrespective of incorporation of anthelmintic, as well as the supplementation, is sufficient to effectively reduce establishment of new infections. Further work by Maria *et al.* (1996) lends support to this assumption whereby medicated or unmedicated urea molasses blocks were effective in reducing establishment of new infections. Hence, it is recommended that the unmedicated blocks be given where supplementation is required, hence reducing the likelihood of anthelmintic resistance.

Chandrawathani *et al.* (1997) gave medicated urea molasses blocks to all animals in a smallholder sheep farm at a restricted economical intake of 60g/animal/day. The animals grazed permanently on heavily contaminated vegetation (indicated by egg count >7000 epg) under oil palm trees. After an initial moxidectin drench and access to the blocks, egg counts remained below 300 epg over three months.

Plants as anthelmintics

This aspect of ethnoveterinary medicine is at a fledgling stage in Malaysia although there are undocumented reports of the use of tamarind juice and legumes to treat worms in goats.

When fresh leaves of the Neem tree (*Azadirachta indica*) were fed to a group of trichostrongyle-infected sheep faecal egg counts and larval recoveries were reduced. The number of worms recovered in the Neem fed sheep was only 5-15% compared to that of the control sheep (Chandrawathani *et al.*, 2002c). Neem leaves were acceptable to the animals and there was no indication of toxicity. Clearly, there is potential for more investigation into the anthelmintic properties of this plant.

3. Breeding

There are few reports in Malaysia regarding genetic resistance to parasites. Over a period of 9 months, worm egg counts were monitored in weaned lambs of the local long-tail wool sheep and compared with those of the imported 'Cameroon' hair sheep crosses (Pandey, 1995). This study found that the crossbreeds were more resistant to *H. contortus* than the local wool sheep. However, a later study on the same farm involving 42 female 50% Polled Dorset x Malin (Malaysian indigenous breed) wool sheep and 20 female 25% Cameroon hair sheep grazing together, showed no difference in egg counts from birth to 13.5 months (Sani, 1994). It is important to note that the wool sheep on this particular farm have been selected for improved production and hence inadvertently, for worm resistance, for more than 15 years.

A newly imported hair breed from Brazil, the Santa Ines, was studied for worm resistance purely because there were large number of animals available from which nucleus flocks of resistant and susceptible animals could be created. Selection of this breed, based on field and challenge infections, showed 20-30% resistant individuals. Mating of the resistant individuals produced resistant offspring (Sani *et al.*, 2000).

4. Biological control

Initial bio-control research in Malaysia used the fungus, *Arthrobotrys oligospora*, found in cattle dung, on *Strongyloides papillosus* larvae (Chandrawathani *et al.*, 1998b). Two laboratory trials were conducted to determine the effect of *A.oligospora* spores on the development of *Strongyloides papillosus* eggs in cultures of bovine faeces. Both studies showed that a concentration of 2000 conidia/g faeces virtually eliminated infective larvae (>99% reduction), following 14 days incubation under ideal conditions for free living development of this larve. This work has demonstrated, in principle, that *A. oligospora* could provide a practical biological control agent against *S. papillosus* infecting intensively raised young ruminants in the humid tropics and subtropics.

Investigations of the more robust *Duddingtonia flagrans*, as a nematophagous inclusion in animal feed are on-going. Studies of *Duddingtonia flagrans* commenced with a faecal survey for naturally occurring nematode trapping fungi (Chandrawathani *et al.*, 2002a). The fungus was grown on local media such as wheat grains, paddy and millet and prepared for feeding to small ruminants and also incorporated into urea mollasses blocks. These two delivery methods (feed granule supplement and nutrient block) were found to be suitable for feeding sheep and goats. Studies of an isolate of *D. flagrans*, identified by the Veterinary Research Institute, showed that it could reduce larvae development by nearly 95% in worm-infected animals fed 6 million spores each (Chandrawathani *et al.*, 2002b). However, when spores were incorporated into feed blocks, the intake of blocks affected the efficacy of larvae reduction. This is because the number of spores available is proportional to the quantity of block intake which varies with the individual animal; the weaker animal consuming less. Furthermore, the storage of blocks incorporated with fungal spores is an important factor in the efficacy of the fungus. It is ideal to store the blocks in cold room facilities as this can extend the shelf life of the spores.

Further trials were conducted on penned animals artificially infected with *H. contortus*, using dose rates of 125,000 and 250,000 spores per kg as a feed supplement, as well as via blocks. The spores were able to reduce larvae by 80-90% within 48 hours and the effect was seen at least 3-4 days post treatment. In another trial involving grazing sheep fed with 500,000 spores/kg spores tended to reduce pasture contamination thereby lowering the rate of re-infection to sheep, over a period of three months. Untreated controls had higher faecal egg counts as a result of continuously grazing contaminated pastures. The total worm counts of tracers indicated a higher level of larval contamination in the pastures grazed by the untreated control sheep.

In the final trials, involving large scale sheep farms in Infoternak and Calok, fungal spores were fed at a dose rate of 500,000 spores/kg. Results clearly showed that simultaneous use of spores and a 10–paddock rapid rotational grazing strategy was an excellent way to reduce pasture contamination to a minimum, such that anthelmintics need not be used. This demonstrates the ultimate use of nematode trapping fungi in systems where anthelmintics are ineffective as a result of resistance.

CONCLUSIONS

The worm profile of small ruminants in Malaysia, and the nature of infection in traditional smallholdings, open pastures and under plantation crop management have been documented. This provides for a sound foundation to formulate control programmes for worms in the various animal management systems. The wide availability of the major groups of anthelmintics coupled with government subsidies for supporting ruminant health has led to the emergence of widespread anthelmintic resistance.

However, chemical dewormers remain the most used form of control. Strategic treatment based on faecal egg count (FEC) appears to be well adopted on government and commercial farms. The animal health worker monitors the FEC of the farm by sending samples to the nearest government laboratory. The managers are advised to treat if 30-40% of the flock has FEC>1500. When treating animals it is recommended that drugs are rotated (i.e. two drugs per year) and that strict precautions such as fasting animals before treatment and calculating dosage based on the heaviest animal be adopted.

Grazing management using rotational systems based on epidemiological knowledge is a success on government farms that are consistent in their practice. Rotational grazing has not been well adopted in plantations because plantation managers are not convinced of the benefits. Moreover, plantations currently prefer rearing cattle, rather than small ruminants, as cattle appear to be less problematic and provide better returns.

Feed blocks are very popular but their cost is a constraint. Their popularity stems from improved productivity from increased nutrition, rather than the medication in the block. This has been clearly demonstrated by comparing the performance of non-medicated and medicated blocks.

Breeding for resistance works well in the hands of researchers but as there is no organised breeding plan for worm resistance on government farms, this approach to worm control has not been adopted by managers of government breeder and multiplier farms. Selection of breeding animals is based on body weight and breed conformation. Sheep breeding farms are now using only hair breeds which are imported because of their reputation for resistance to worms.

Biological control using nematophagous fungi is in the developmental research stage. Where animal rearing is a secondary source of income, farmers are less willing to experiment with, or commit to, techniques to improve their husbandry. Smallholder farmers usually depend solely on chemical control. The farmers who succeed in making small ruminants a primary enterprise are those who have invested heavily in their farms and are open to suggestions.

The 'entrepreneurial producer' does use a worm control programme. He ensures good sanitation, applies principles of good nutrition and provides proper housing with raised, slatted flooring. He does all this in the name of good management rather than consciously thinking of sustainable parasite control. After their considerable investment in the small ruminant enterprise these farmers will adopt other practices instead of depending on chemical dewormers. Farmers who face anthelmintic resistance confine their animals and feed them cut-and-carry forages.

The future for work in worm control in small ruminants in Malaysia, apart from resistance management and exploring medicinal plants, is to expose farmers to the options available to them. The continuing education process of animal health workers who are closest to the farmers therefore cannot be overemphasised.

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