Nematode parasite control in ruminants - Current status

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Helminth infections espesiallly due to nematode parasites has been recognized as a serious constraint in all livestock production systems. In the traditional sense of chemotherapy-chemo prophylaxis the developed world has achieved maximum effect of what is possible, from excellent anthelmintics developed by the phar maceutical industry over the last forty years i.e., from thiabendazole through levamisole and morantel tartrate to more advanced benzimiazoles (BZ) and to the avermectins and milbemycins (AVM).

Estimated conservatively, the R& D (including discovery, development, testing and attention to socio-political aspects including food/user safety, ecotoxicity) of a pharmaceutical prepara tion for use in food producing animal requires a commit-ment of US $ 100-200 millions and takes up to 10 years. The escalating costs are a powerful disincentive for the continued development of new animal health product, all the more so when one balances developmental costs with the relative industry sales shares (Hennessy, 1997).

Apart from the enormous and exponentially increasing costs associated with the new product research and development, the pharmaceutical industry now faces added costs associated with increasing scrutiny with regard to food safety, animal welfare and environmental issues as well as defensive spending needed to support currently registered products. In relation to the latter issue, some products have been withdrawn from the European market. This can have an adverse flow on to other countries, particularly those with more extensive animal production systems such as the developing world, where products could still be used in an acceptable manner.

It has been estimated that the world anthelmintic sales contribute to only approximately 9 percent of the total animal health sales. Hence there is little incentive to expend the time and significant financial expense for such a small market. **It is universally accepted acknowledge among Parasitologists that existing anthelmintics must be preserved and utilized judiciously to ensure continuous effectiveness.**

Anthelmintic resistance

Broadly, resistance is the ability of parasites to survive doses of drugs that could normally kill parasites of the same species and stage. It is inherited and selected for because the survivors of drug treatment pass genes for resistance on to their offspring. Resistance genes appear to be carried on chromosomal DNA. These genes are initially rare in the population or arise as rare mutations in genes, but as selection continues the proportion of resistance genes in the population increases as does the proportion of resistant parasites (Sangster,2001).

There is no doubt that anthelmintic resistance is the greatest threat to continuing small ruminant livestock production throughout the tropics/subtropics. High levels of resistance have been reported to all major groups of anthelmintics from all parts of the world where anthelmintics are used intensively in small ruminants. High levels of resistance particularly to BZs, in parasites of small ruminants and multiple resistance involving

broad spectrum anthelmintic groups and closantal has been reported from South east Asian countries. In Kenya, resistance is widespread particularly to the BZs owing to poor quality drugs commanding a major share of the market. (Wanyangu *et al.* 1996).

The extraordinary levels of safety, wide spectrum of activity and relative cheapness of modern broad spectrum anthelmintics, often combined with aggressive marketing practices of retailers have led owners of large numbers of livestock in the tropics/ subtropics to treatment in a frequent haphazard manner. Efforts to change these practices have met with considerable success in Australia with development and promotion of a number of regional worm control programmes. (Waller *etal.*1993). The aim of these programmes is to maintain high levels of animal production, to prevent clinical disease, but most importantly to reduce the frequency of treatment by recommending strategic treatment base on the epidemiology of parasitic infection. As these programmes represented a radical departure from regular practices, to ensure good levels of adoption by farmers. It was supported by massive education programme.

In an elaborate and painstaking work conducted by Roberts in Srilanka on toxocarosis of calves, it was reported that buffaloe calf mortalities caused by massive transmammary parasite infection can be prevented by the simple expedient of treating all calves with pyrantel, an extremely cheap anthelmintic, within 12 to 16 days of birth. The number of larvae passed through milk after tenth day of parturition is minimum and hardly warrants treatment. This control programme has been promoted to the largely illiterate farming communities in Srilanka using education based on simple pictorial representation of the steps to that need to be taken (Roberts, 1993).

Methods to overcome anthelmintic resistance

Utilizing host physiology

For BZ and IVM classes of compounds efficacy is principally dependent upon the duration during which concentration that are toxic to the target parasite are present. The goal therefore is to extend drug presence for as long as possible. When orally treating ruminants it is crucial that the drench wholly lodges within the rumen. BZ and IVM compounds strongly associate with particulate matter in the rumen and the residence time of this complex provides the reservoir from which absorption of the drug from the more distal sites following digesta passage is prolonged. The act of drenching particularly if the drench is presented to the buccal cavity can stimulate closure of esophageal groove with significant drench bypassing the rumen (Prichard & Hennessy, 1981). Bypassing the rumen can be largely avoided with correct administration with the drench dispensed directly into the esophagus.

Since rumen volume remains essentially constant, an inverse relationship between feed intake and digesta residence time exists. A large feed intake, particularly feed has a high water content increases gastric transit and reduces the duration of drug availability. It has been conclusively demonstrated that the kinetic dispension of all the current anthelmintics on reduced feed intake is increased (Hennessy, 1997).

In developed countries of the world, which have significant sheep population, anthelmintic resistance has been the single most dominant factor that spurred researchers and extension personnel, working on helminth parasite control, to promote schemes, which do not rely exclusively on the use of anthelmintics. It is an unfortunate fact of life that little seems to be done to ameliorate problems until they reach the stage when alternatives are limited and /or expensive. So it is with anthetmintic resistance.

Multiple high level anthelmintic resistance in nematode parasites of sheep and goats in now commonplace throughout the tropics/ subtropics. Alternative approach to nematode control other than intensive anthelmintic treatment, has received greater attention in recent years. **For any nematode parasite control scheme to be sustainable, however, will still require the judicious, infrequent use of effective anthelmintics.**

Alternative methods of nematode control suggested/ worked out from other countries include exploiting breed resistance, grazing management worm vaccines, biological control and supplementary feeding.

Fungal biocontrol of parasites of livestock using nematophagous fungi is arguably more applicable to the tropics/subtropics particularly when combined with supplementary feeding. Biological control using nematophagous fungi is a promising area. Current research being carried out is primarily in Australia and

Denmark include daily feed supplements, feed blocks and sustained release capsules containing fungal spores. Block formulations containing nematophagous fungal spores could prove to be a practical control option in the humid tropics/subtropics where tethered husbandry and night housing with stall feeding are common management practices and where anthelmintic resistance is a serious problem. The fungi can act on a range of nematode parasites not only within but also between species of livestock. The farmers can capitalize on the increasing demands by consumers for chemical free livestock products.

Vaccines

Attempts to produce vaccines for the important gastrointestinal parasites of livestock using the attenuation procedures and the molecular approach using antigenic fractions of parasitic material, have failed to provide the basis for a viable commercial product. One factor that conspires against the acceptance of the worm vaccine approach to nematode parasite control is that they have to compete with modern anthelmintics, not only in terms of cost, but also with regard to efficacy. Mathematical modeling of consequences of vaccination has been a viable means of predicting outcomes, and certainly justifying research in worm vaccines of ruminant livestock. Such work has shown that substantial benefits are likely to be obtained even with 60 per cent efficacy in 80 per cent of the flocks.

The market led approach to vaccine development will lead to the arrival of a number of molecular vaccines against parasites of pests. On the other hand the driving force behind the development of livestock vaccines will be consumer pressure for green food with concern for environment and for animal welfare.

There are a number of important principles, and practices that should be heeded, or implemented if livestock owners wish to remain in business. Many of these will be inappropriate or impractical for specific livestock enterprises but serious attempts should be made to adopt them in an effort to prevent the seemingly inevitable breakdown of worm control.

Substandard products now command a significant and increasing share of marketplace in many countries in the tropics/subtropics and this is made much worse by widespread practice of drug adulteration and substitution (Waller, 1996b).

It is now becoming clear that indigenous livestock breeds that have evolved over the centuries in diverse and often stressful tropical environments possess a range of unique adaptive traits that enable them to survive and remain productive in these environments. Planned breed substitution with selected indigenous breeds offers a simple, quick and economically viable preventive measure in tropical countries.

Factors involved in the development of resistance can be divided in to genetic, biological or operational factors and only operational (management) factors are under human control. Organisms in the environment (larvae/ eggs in the pasture) which are nor exposed to drugs are in refugia. The higher the proportion of the population in refugia, the slower the selection for resistance. Under hot dry weather conditions when the pasture refugium is small, resistance can develop rapidly (Sangster, 2001).

Integrated pest management is the planned integration of a range of methods and techniques to minimize the use of drugs and at the same time maximize profitability of the farming enterprise.

It is worth noting that many parasite control schemes use chemical treatment in a strategic or prophylactic fashion to minimize the build up of infective stages. One approach to reducing treatment frequency is to measure infection or the risk of infection and treat tactically when levels reach the threshold. Infection levels of internal parasites are assessed by egg counts. Other useful approaches may be to forecast infections and treat prior to population expansions. Geographic information systems have been used to assess infection risk for certain parasites.

Major changes need to be made to tackle nematode parasite control in future. This will depend on coordinated, continued and committed education and technology transfer from scientists to advisors and then to farmers.

There is no doubt that the development of widespread high level anthelmintic resistance represents the greatest single threat to the control of G.I parasitism.in small ruminants in the humid regions of the developing world. With increased intensification and scaling up of small ruminant operations, anthelmintic treatment has become frequent and haphazard-the two factors responsible for the development of drug resistance. This has been exacerbated by proliferation

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