



**VLA PARASITOLOGY GROUP**  
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## INTRODUCTION.

This is a summary of papers published in 2005 in the areas of parasitology thought to be of most relevance to the work of the VLA, and also reflecting the expertise of the group. Parasitological research appears to be strong particularly in the areas of parasites of zoonotic concern, e.g. cryptosporidiosis and *Echinococcus granulosus*. Studies into drug resistance are also prominent. Other areas where a number of papers are being produced include *Ostertagia ostertagi* infection and its effect on milk yield in dairy cows. This year also saw the launch of a new class of anthelmintics by Bayer. At present it is only available as a formulation for cats.

## CRYPTOSPORIDIOSIS

### Animal disease

A new species of *Cryptosporidium*, *C. bovis*, has been described. Oocysts of *C. bovis*, previously identified as *Cryptosporidium* genotype Bovine B, are morphologically indistinguishable from those of *C. parvum*. Based on these biological and molecular data, the authors consider this highly prevalent *Cryptosporidium* that infects primarily postweaned calves to be a new species and propose the name *Cryptosporidium bovis* n. sp. for this parasite.

*Cryptosporidium bovis* n sp (Apicomplexa: Cryptosporidiidae) in cattle (*Bos taurus*).  
Journal of Parasitology 91 (2005) 624-629.

*Cryptosporidium parvum* has been confirmed using molecular methods in the Przewalski's horse and in domestic horses in both an outbreak of foal diarrhoea in New Zealand and a convenience sample survey of horses in West Wales in 2002. Significance of *Cryptosporidium parvum* in horses. Veterinary Record. 156 (2005) 688

Studies following the detection of *C. andersoni* in the UK from the faeces of a 5-year-old dairy cow with diarrhoea were presented. Oocysts were identified by genus-specific immunofluorescence and differential interference contrast microscopy. Detection of *Cryptosporidium andersoni* in a dairy cow with diarrhoea in the UK. Veterinary Record. 156 (2005) 423

Ovine colostrum and milk from immunised ewes were tested for their ability to prevent cryptosporidiosis in the lambs experimentally infected with 10<sup>6</sup> oocysts of *Cryptosporidium parvum* at 36-48 h of age (day 0 post-infection). All lambs became infected and developed clinical cryptosporidiosis. However, lambs fed by immunised dams have shown shedding involved, significantly, fewer oocysts and lasted for a shorter period than in control lambs. In addition, diarrhoea was less severe. These results indicate that lactogenic immunoprophylaxis should help mitigate the financial losses caused by cryptosporidiosis in small ruminants, as well as reducing the risk of infection of humans through the decreased contamination of the environment with oocysts. Martin-Gomez, S; et al. Veterinary Parasitology 129 (2005) 11-20

The first worldwide report into the infection of poultry with *Cryptosporidium hominis* and *C. parvum* was presented at the WAAVP Conference in Christchurch, October 2005. Michaela Giles and co-workers at VLA Weybridge indicated chickens and

turkeys produced oocysts of both *C. hominis* and *C. parvum* following experimental dosing with oocysts. "Preliminary evidence that the host range of *C. hominis* and *C. parvum* of human origin may include chickens and turkeys", Giles *et al.* Proceedings of WAAVP 20<sup>th</sup> International Conference, New Zealand, October 2005.

A paper reviewing the *Giardia* and *Cryptosporidium* in mammalian wildlife is of interest to VLA because of current research jointly being conducted with the Health Protection Agency (HPA) into cross-infections between mammals and humans. In this article, the authors review current knowledge about the diversity of free-living and captive terrestrial and marine mammalian wildlife species infected with *Giardia* and *Cryptosporidium*. Applebee *et al*, Trends in Parasitology 21 (2005) 370-376.

### **Concurrent infections**

At the International Coccidiosis Conference in Brazil, Ralph Marshall reported on some experimental work at VLA looking at concurrent infections between *C. parvum* and *E. coli* O157:H7 in lambs. It was concluded that in certain conditions *C. parvum* may enhance the colonisation and persistence of *E. coli* O157 and also the intimate attachment and formation of AE lesions in small ruminants. "Interaction between *E. coli* O157:H7 with *Cryptosporidium parvum* in 6-week-old lambs". Marshall *et al*, Proceedings of 9<sup>th</sup> International Coccidiosis Conference, Brazil, September 2005

### **Detection**

Jackie Marshall and colleagues from VLA and the HPA presented results for a Fluorescent Antibody Test (FAT) for the detection of *Cryptosporidium* oocysts. The results indicate that the FAT is more sensitive than the modified Ziehl-Neelson (mZN) staining technique routinely used at VLA, and furthermore is *Cryptosporidium*-specific, thus eliminating false positive results. "Comparison between the modified Ziehl-Neelson and fluorescent antibody tests for the detection of *Cryptosporidium* spp. oocysts in faeces". Marshall JA *et al.* Proceedings of 9<sup>th</sup> International Coccidiosis Conference, Brazil, September 2005, and WAAVP 20<sup>th</sup> International Conference, New Zealand, October 2005.

An interesting test for the presence of *Cryptosporidium* oocysts in faeces was reported from Canada. The system used an immunochromatography test kit comprising a bottle of reagent into which the faeces were placed, followed by the insertion of an "immunostrip". When the results were compared with more expensive and complicated PCR techniques a good correlation was observed. VLA has just obtained some of these immunostrips and will be trialing them in 2006. "Multiattribute evaluation of two simple tests for the detection of *Cryptosporidium parvum* in calf faeces". Trotz-Williams *et al*, Veterinary Parasitology 134 (2005) 15-23.

It is reported from Japan that a research group from Osaka have developed *Eimeria* monoclonal antibodies which cross react with *Cryptosporidium parvum* and *C. muris*. Further work is ongoing to see if there are any practical applications for these antibodies. "Cross-reactivities with *Cryptosporidium* spp. by chicken monoclonal antibodies that recognise avian *Eimeria* spp.", Matsubayashi *et al.* Veterinary parasitology 128 (2005) 47-57.

### **Treatment**

Two commercial peroxygen-based disinfectants containing hydrogen peroxide plus either peracetic acid (Ox-Virin) or silver nitrate (Ox-Agua) were tested for their ability

to inactivate *Cryptosporidium parvum* oocysts. Both disinfectants had a deleterious effect on the survival of *C parvum* oocysts, since disinfection significantly reduced and in some cases eliminated their viability and infectivity. These findings indicate the potential efficacy of both disinfectants for *C parvum* oocysts in agricultural settings where soil, housing, or tools might be contaminated.

Efficacy of two peroxygen-based disinfectants for inactivation of *Cryptosporidium parvum* oocysts.. Applied and Environmental Microbiology 71 (2005) 2479-2483

Thirty-one Holstein bull calves were purchased at birth from 3 dairy farms in Eastern Ontario. Each calf was assigned at random to oral treatment with either 5 mg of halofuginone lactate in 10.0 ml of aqueous carrier solution or 10 ml of placebo. Intake of milk and starter, body weight gains, and age at weaning were not significantly different between treatment groups. Effect of halofuginone lactate on the occurrence of *Cryptosporidia parvum* and growth of neonatal dairy calves. Journal of Dairy Science. 88 (2005)1801-1806

### Zoonotic aspects

Cattle are known reservoirs and asymptomatic excretors of *Cryptosporidium*, a protozoan parasite that causes severe and protracted diarrhoea in people. The incidence of *Cryptosporidium* was investigated in 288 matched samples taken from beef carcasses of 1 g samples of faeces retrieved immediately after de-legging, 25 cm<sup>2</sup> samples of beef excised from the rump of uneviscerated carcasses, and 25 cm<sup>2</sup> samples of beef excised from the brisket area of eviscerated carcasses.

*Cryptosporidium* species were detected in 21 of the faecal samples after salt flotation and immunofluorescent microscopy. The species isolated from the positive samples were identified by restriction fragment length polymorphism and PCR as *Cryptosporidium andersoni* (54.5 per cent) and *Cryptosporidium parvum* genotype 2 (45.5 per cent). In the faecal samples, there was a significantly higher prevalence of the parasite in samples taken in summer (May to July) and winter (November to January) than in spring or autumn. No *Cryptosporidium* samples were recovered from any of the beef samples.

Prevalence and characterisation of *Cryptosporidium* species in cattle faeces and on beef carcasses at slaughter. Veterinary Record. 156 (2005) 165-168

A total of 427 faecal samples from cattle (411) and sheep (16) in Scotland, UK, were analysed during a survey for the occurrence of cryptosporidiosis in September 1999-2001. It was shown that all 16 isolates from sheep were identified as *Cryptosporidium parvum*, while 409 and 2 isolates from cattle were identified as *C parvum* and *C hominis*, respectively. This is the first report of natural infection and completion of the life cycle of *C hominis* in livestock

Smith *et al* reported the first cases of *Cryptosporidium hominis* infections in cattle in Scotland. Of 411 bovine faecal samples examined from clinically ill animals 409 contained *C. parvum*, and the other 2 were *C. hominis*. One animal was a three-day-old calf, but the other was a six-year-old cow, highlighting the need to consider cryptosporidiosis in older animals. "Natural *Cryptosporidium hominis* infections in Scottish cattle", Veterinary Record. 156 (2005) 710-711

Fifty-two faecal samples from horses and foals were obtained in Wales, UK, in May June 2002. Oocysts were detected by the immunofluorescent antibody test in 2 faecal samples, which was designated as *C parvum* genotype 2 by polymerase chain reaction (PCR). Both samples were from foals aged less than 8 weeks. The zoonotic potential of this organism is briefly discussed. Identification of *Cryptosporidium parvum* genotype 2 in domestic horses. Veterinary Record. 156 (2005) 49-50

Little is known of the prevalence of *Cryptosporidium* and *Giardia* parasites in sheep and the genotypes that they harbour, although potentially sheep may contribute significantly to contamination of watersheds. Analysis revealed that although both parasites were detected in a high proportion of samples by PCR, with the exception of one *Cryptosporidium hominis* isolate, the majority of isolates genotyped are not commonly found in humans. These results suggest that the public health risk of sheep-derived *Cryptosporidium* and *Giardia spp* in catchment areas and effluent may be overestimated and warrant further investigation.

Sheep may not be an important zoonotic reservoir for *Cryptosporidium* and *Giardia* parasites. *Applied and Environmental Microbiology*. 71 (2005) 4992-4997

## TRICHINELLOSIS

Only a few studies have compared the muscle distribution of the different *Trichinella* genotypes. In this study, data were obtained from a series of experimental infections in pigs, wild boars, foxes and horses, with the aim of evaluating the predilection sites of nine well-defined genotypes of *Trichinella*. Necropsy was performed at 5, 10, 20 and 40 weeks post inoculation. From all host species, corresponding muscles/muscle groups were examined by artificial digestion. In foxes where all *Trichinella* species established in high numbers, the encapsulating species were found primarily in the tongue, extremities and diaphragm, whereas the non-encapsulating species were found primarily in the diaphragm. In pigs and wild boars, only *Trichinella spiralis*, *Trichinella pseudospiralis* and *Trichinella nelsoni* showed extended persistency of muscle larvae (ML), but for all genotypes the tongue and the diaphragm were found to be predilection sites. This tendency was most obvious in light infections. In the horses, *T. spiralis*, *Trichinella britovi*, and *T. pseudospiralis* all established at high levels with predilection sites in the tongue, the masseter and the diaphragm. For all host species, high ML burdens appeared to be more evenly distributed with less obvious predilection than in light infections; predilection site muscles harboured a relatively higher percent of the larval burden in light infections than in heavy infections. This probably reflects increasing occupation of available muscle fibers as larger numbers of worms accumulate. Predilection sites appear to be influenced primarily by host species and secondarily by the age and level of infection.

Kapel, C. M. O. et al. *Veterinary Parasitology* 132 (2005) 101-105

The Canadian Food Inspection Agency (CFIA) has developed a program to accredit external laboratories to conduct *Trichinella* digestion assays for export purposes. Accredited laboratories are responsible for staffing; equipment and operating test facilities under the auspices and guidance of the CFIA. The CFIA's Centre for Animal Parasitology provides training, proficiency samples, audits and other support for the accreditation process. The program has also been adapted for use in laboratories conducting *Trichinella* digestion tests for surveillance and food safety purposes and provides a useful template for others wishing to develop similar systems.

Forbes, L. B et al *Veterinary Parasitology* 132 (2005) 173-177

The European Union (EU) countries are searching for new ways to certify meat free of *Trichinella*; however, with the expansion of the EU, the acceptance of a unilateral method is complicated by the variability of pig and human trichinellosis among EU countries, where significantly higher prevalence rates have been observed in the

newly added eastern countries. Several attempts have been made to define *Trichinella* -free areas, but certification of *Trichinella* -free pig production farms appears to be the only feasible approach. The increasing prevalence of the non-encapsulating species, *Trichinella pseudospiralis*, in game, domestic pigs and humans has eliminated the compression technique from the new EU legislation to be enacted in 2006. Also, the observation that several species of *Trichinella* tolerate freezing in horse meat for up to 4 weeks has forced a change in legislation as freezing is no longer an option for certifying horse meat. Because current serological detection methods are not suited for meat inspection, classical direct detection methods and inactivation by freezing remain the methods of choice for pork. It has been proposed, therefore, to automate direct inspection methods as a cost effective alternative to certify pig farms free of *Trichinella*.

Kapel, C. M. O. *Veterinary Parasitology* 132 (2005) 189-194

The proceedings of the 11<sup>th</sup> International conference on Trichinellosis provide a comprehensive review. The genetics, physiology, biology and life cycle of *Trichinella* spp. and the epidemiological, immunological, physiopathological, clinical, diagnostic and food safety aspects of trichinosis in domestic and wild animals and humans are all discussed.

Trichinellosis: Proceedings of the Eleventh International Conference on Trichinellosis, San Diego, CA, USA, 8-12 August 2004.

Zarlenga, D *Veterinary-Parasitology*. 2005; 132(1/2): x + 202 pp.

## ECHINOCOCCUS SPECIES

In the UK the possible re-emergence of canine echinococcosis infection in Wales was highlighted in 2005. In this they reported the results of a survey in dogs in Powys, Wales, looking at the prevalence of coproantigens of *Echinococcus granulosus* from 1996-2002. There was an increase from 3% to 8%. The risk factors for a coproantigen positive dog were low anthelmintic dosing frequency and allowing dogs to roam. It was suggested the hydatid control programme was prematurely stopped in this area. (Bushi, I, et al. *Emerging Infectious Diseases* 11(2005) 568-571

A paper at the Prevention and control of zoonoses conference: from science to policy (June 2005) by Philip Craig, highlighted this study and also the risk to UK from the more pathogenic form of human hydatidosis (*Echinococcus multilocularis*), as Europe's main endemic area expands. Human, wild and domestic pig infections have been reported in Belgium and the Netherlands as well as the historical endemic areas of France, Germany, Austria and Switzerland. There is also evidence of infection with *E. multilocularis* in other European countries from studies in foxes. There is less evidence of the problem in southern Europe.

Human echinococcus infection due to both *E. multilocularis* and *E. granulosus* is a significant problem in the Sichuan district of China. They are attempting to control it by vaccination of the sheep and goats against *Echinococcus* spp (although there is a problem in getting the animals to respond to the vaccine due to very heavy fluke burdens, leading to a reduction in antibody response). (20<sup>th</sup> International conference of the World Association for the advancement of veterinary parasitology (WAAVP) proceedings. Abstract N7.3)

A review of *E. granulosus* (hydatid) control in Australia was published this year.

*Echinococcus granulosus* was imported into Australia with domestic livestock about 200 years ago. Australian wildlife were highly susceptible to infection and the wildlife reservoir has hampered hydatid control campaigns on mainland Australia but successful eradication has been achieved in the island state of Tasmania where there was no wildlife reservoir. The application of a new recombinant vaccine for sheep in control campaigns and the use of praziquantel baits for controlling infection in dingoes around bush campsites and picnic areas is discussed.

Jenkins, D.J. *International-Journal-for-Parasitology*. 35 (2005) 733-740

## **ECTOPARASITES**

### **Cattle ectoparasites**

The distribution of literature in 2005 favoured traditional and emerging methods for control of ectoparasites rather than literature related to the parasites themselves.

#### Parasite Epidemiology

Hypodermosis has been successfully eradicated from many Northern European countries including GB by the use of chemotherapy. However, in areas where no prophylactic therapy is used, prevalence can be high and its impact significant. A survey was carried out in Albania over two seasons – spring and autumn 2003 involving 625 cattle. Sample size calculations were based on a prevalence of 20%, which slightly underestimated the samples required for 95% confidence for the autumn bleed (372). In addition, monthly milk samples were collected over a five month period from October 2002 from four animals. Serology indicated prevalence of 38.6% in spring and 41.3% in autumn bleeds and regional differences with 3 of the 4 milkers showing an antibody response. Both blood and milk antibody levels peaked during the period of larval migration over the winter months. A total of 120 third stage larvae were collected and all were *H.bovis*.

Otranto, D., et al. *Veterinary Parasitology* 128 (2005) 157-62.

#### Treatment

A study was undertaken to evaluate the effect of eprinomectin pour on solution at 0.5mg/kg body weight for the treatment of adult cattle infested with *Chorioptes bovis*. From a group of 12 infested animals, 6 were treated with 6 left as controls. Skin scrapes were taken prior to treatment, at day 7 post treatment and then at weekly intervals for 8 weeks. The authors reported that mite counts were reduced by 100% from day 14 to the end of the study. In addition, they also indicated that body weight gain in treated animals was higher with lack of statistical significance a consequence of small study size.

Rehbein, S., et al. *Parasitology Research* 98 (2005): 21-25.

A trial involving 500 calves investigated the effects of lice infestation during their first winter period with hide damage at slaughter at 26 months of age was described. Eprinomectin was used to keep 100 calves free of lice during the first winter period with all cattle receiving treatment in their second winter. Hide damage was more significant in the animals which had been infested as calves. The authors conclude that although improvements in leather quality were seen in lice free animals, there is no financial benefit to the producer. The use of MLs to treat against lice routinely in cattle conflicts with the need for strategic use of available anthelmintics in order to slow down resistance.

Hadley, P. J., et al. *Veterinary Record* 157 (2005) 841-844.

There are stringent import procedures in place when importing cattle from Mexico to the US to prevent import of *Boophilus* sp. *Boophilus microplus*, which does not occur in the UK. It is significant in sub and tropical regions as the primary vector of babesiosis. However, due to the rise in resistance to OPs the use of macrocyclic lactone products as an alternative to coumaphos was investigated. The effectiveness of a single treatment of either ivermectin or moxidectin (200µg/kg) was determined for all developmental stages of ticks. The therapeutic level of control obtained at the time of treatment was over 99% for both with  $\geq 99.7\%$  efficacy demonstrated for adults and nymphs. For larval stages the efficacy was lower – 97.9% and 98.4% for ivermectin and moxidectin respectively. Residual activity was low with both remaining above the threshold level needed for eradication programmes. Moxidectin had better residual activity than ivermectin with 92% at 1 week and 19% at four weeks. The difference in efficacy between coumaphos and the MLs against larvae was considered critical as larvae can easily be missed at border inspections. The results of the study would not permit the authors to recommend the MLs as a replacement although higher concentrations of product may prove more effective.

Davey, R. B., et al. *Experimental and Applied Acarology* 35 (2005) 117-129.

### Biological control

Biological pesticides based on entomopathogenic fungi have been investigated as a promising option. However, they are affected by a variety of environmental factors with temperature having a particularly detrimental effect. This study compared the performance of two fungal isolates against *B. microplus* in a field study and investigated the effect of temperature – a standard 28 °C compared to 30-35 °C, to reflect conditions on cattle skin. In addition they monitored cattle skin temperature which revealed that average and diurnal fluctuation varied on different regions- some of which were out of the 30-35 °C range. A decrease in tick number was shown between the control animals and the fungal isolates with one isolate significantly better than the other. However, three weeks after treatment the average number of ticks on the better treatment was still 8.5. Fungal treatments are slower to cause effect than traditional methods and so presumably this is not an indication of limited residual effect. The temperature experiments revealed that survival time of the tick was shorter at the lower temperature. This appears to be a typical finding as on animals pathogenic fungi are working in temperatures toward the top of their range. However, one fungal isolate was more temperature tolerant and the authors' surmised that the use of isolates adapted to the microclimate found on cattle may be the key to the development of a biological pesticide for the control of cattle ticks.

Polar, P., et al. *Veterinary Parasitology* 134 (2005) 159-67.

## **Pig Ectoparasites.**

### Sarcoptic Mange

Modern management practices are believed to have all but eradicated sarcoptic mange (*Sarcoptes scabiei*) and large roundworms (*Ascaris suum*) in the USA. However a group of US pig vets are worried that these practices are giving a sense of false security, in that mange and worms are still present and making economic damage without noticeable mortality or morbidity. Clinical signs may be minimal. To determine if worms are present faecal egg counts should be carried out on sows and

finished pigs at least once or twice a year. Microscopic examination of ear scrapings continues to be the best way of detecting mange mites, but can be difficult to identify low-level infestations. Two other procedures can help diagnosis mange: papular dermatitis scoring (PDS) and ELISA. Assessing the level of dermatitis at slaughter is probably the best diagnostic tool for assessing the severity of “hypersensitive mange” in a herd. Pigs should be examined after they have been scalded and while on the slaughter line. A PDS (mild, moderate or severe) is given to each pig and an average dermatitis score (ADS) calculated for all pigs in the group.

Papular dermatitis scoring was carried out in the USA in 1996, 2002 and 2004 using seven packing plants in seven States. The 1996 survey evaluated almost 28,000 pigs and the overall prevalence of mange (defined as a proportion of herds with an ADS of 0.5 or above) was 43%. The 2002 a survey was carried out in the USA and in 2003 a survey was carried out in Canada. Prevalence of mange was similar in both countries. In the USA 29% of lots had ADS scores greater than 0.5, with 14% of 21,000 pigs presenting with scores 2 or 3. In Canada 38% of lots had scores of 0.5 and 18% of 11,300 pigs had scores of 2 or 3.

In 2004 39% of lots had an ADS score of 0.5 and of 5,405 pigs evaluated 11.1% had scores 2 or 3. Overall, despite improved management practices, there has not been a significant drop in the level of mange over the last 8 years. The clinical picture for mange may have changed, but mange is still an economical problem.  
Lundeen, T Feedstuffs: Nutrition and Health: Swine. (2005) p10.

The commonly used examination of skin scrapings proved to be insufficient in the diagnosis of porcine scabies. Due to its reliability the German pig health service is using the *Sarcoptes*-ELISA (AFOSA GmbH). In the years 2001 and 2002 a *Sarcoptes suis* eradication was accomplished in two sow farms in the Weser-Ems region and since then the farms have been continuously monitored by clinical examination, as well as ELISA testing and skin scrapings. After two years of monitoring both farms were certified scabies free in November 2003 and June 2004. This *Sarcoptes* eradication is possible even in areas with intensive pig production. When setting up or expanding high health breeding or multiplying herds freedom from mange should be one of the important health targets. The practical results with the use of the *Sarcoptes*-ELISA for monitoring sow farms are promising.  
Baier, S Deutsche tierärztliche Wochenschrift. 112 (2005) 296-269.

Studies in Brazil demonstrated that even though eliminating sarcoptic mange from pigs at farm level is quite straightforward, using doramectin or ivermectin, confirming the success of the procedure remains problematic, especially with a limited number of samples. No single diagnostic tool can be used. Although combining several diagnostic tools (microscopy, clinical assessment, ELISA) can lead to conflicting conclusions, especially in adult animals, it is the only way to objectively establish mange-free status. In the author's experience in Belgium, the accuracy of the elimination treatment and the subsequent measures to prevent re-infection are the best guarantee of success.

Vyt, P. SUIIS 2005( 19 ): p.18-20, 22-24

Sarcoptic mange is still considered a major problem to Brazilian pig production. Studies described the clinical and epidemiological characteristics of a sarcoptic mange outbreak in pigs raised in a confined production system, in Goiás, Brazil. The breeding herd comprised 197 sows and 9 boars. The visit was conducted according

to a standard check list where general conditions and hygiene quality of buildings and animals were identified in relation to the disease epidemiology. From the herd, 18 sows and 5 boars were individually examined and scraping samples were collected from the surface of the external ear for parasitological examination. From these 23 samples, 10 (43.5%) were positive for *S. scabiei* var *suis*. Both hygiene and building conditions were classified as poor. From the 206 breeding stock, 182 (88.4%), as well as the growing and finishing pigs, manifested intense pruritus. The heterogeneity of the animal body score was evident. The pregnant sows showed behaviour disturbance. It is suggested that the poor hygiene conditions of buildings and animals, the aerophagia and the act of biting the pipe and internal and external edge of the ground feeder were related to *S. scabiei* var. *suis* and to the severity of this outbreak.

Sobestiansky, J.; et al. Revista de Patologia Tropical 34 (2005) 61-67

Studies in India assessed the efficacy of extracts of neem (*Azadirachta pinnata*), karanj (*Pongamia pinnata*) and camphor to control porcine sarcoptic mange. Twenty four pigs with naturally infested with *S. scabiei* were randomly divided into 3 groups of 8 pigs each. The first group of pigs received ivermectin (250 µg/kg bwt s/c), the 2nd group received a herbal mixture (50 ml of neem oil, 50 ml of karanj oil, 10 g of camphor and 10 g of sulfur) topically, and the 3rd group served as the untreated control group. Both ivermectin and the herbal mixture had 100% efficacy on the 15th day post-treatment. A few pigs in the 2nd group had reinfestation on the 95th day post-treatment and required treatment with ivermectin. The herbal mixture improved skin condition, and promoted the regeneration of hair.

Bariyar, S.; Prasad, K. D Journal of Research, Birsa Agricultural University 17 (2005) 105-108.

### Demodectic Mange

Mange was investigated in five Large White adult sows refractory to pyrethroid treatment (cypermethrin 15%). The most important clinical signs consisted of erythema, hyperkeratosis, alopecic macules, micaceous scaling, follicular plugging, and numerous comedones, especially on the facial region. Skin samples were scraped and punched. Elongate mites were found that were classified as *Demodex* sp., according to the morphological and histopathological characteristics. The protein, vitamin, and mineral levels contained in the rations were considered to be lower than those recommended to attend the requirements of fattening pigs. Adjustment of the rations was adopted, and the treatment of animals with ivermectin premix (450g/tonne of food) daily orally for a further 7 days was prescribed. The success of treatment was observed 15 days after adoption of these measures, when the beginning of remission of signs was observed. No mites were found on scrapings or biopsy punches after the treatment of the sows.

Santarem V A; et al. (2005). Veterinary parasitology. 131 (2005) 169-171

### Sucking Lice (Haematopinus suis).

No publications in 2005.

## Sheep Ectoparasites

Results of the Moredun Institute's National Sheep Health Survey demonstrated that sheep farmers in England and Scotland have widely differing views on the health and welfare threats facing their flocks. Overall parasitic diseases figure highly. Sheep farmers in England regard anthelmintic resistance as the biggest threat to the English national flock, with sheep scab and internal parasites third and fifth respectively. Scottish farmers regard sheep scab the biggest threat to the Scottish national flock, with anthelmintic resistance a close second. English farmers regard internal parasites, coccidiosis and anthelmintic resistance as the second, fourth and fifth most important threats to their own flocks. Whereas Scottish farmers regard internal parasites, sheep scab and anthelmintic resistance the second, third and fifth most important threats to their own flocks.

Long, J (2005). Survey reveals different attitudes to sheep threats. *Farmers Weekly*. 16<sup>th</sup> December 2005, p41

### Sheep Scab.

Earlier studies of cattle and sheep have demonstrated that *Psoroptes ovis* infestations provoke an intense immunoinflammatory response dominated by eosinophils accompanied by a substantial infiltrate of lymphocytes. However, the kinetics of the lymphocyte response and the subtypes involved have not been characterised. We employed two groups of sheep to investigate the early (1-21 days) and later (21-63 days) infiltration of lymphocyte subpopulations and dendritic cells in primary infestations of sheep with *P. ovis*. Immunohistochemistry indicated that by 4 days after infestation numbers of CD4+ and CD45RA+ cells in lesional skin had increased significantly ( $P < 0.03$  and  $P < 0.005$ , respectively) and that a significant increase in gammadelta T cells and dendritic cells (CD1b+) had occurred by 8 days ( $P < 0.02$  and  $P < 0.01$ , respectively). Numbers of lymphocyte and dendritic cells declined from 49 to 63 days after infestation. Observations suggest that mite-derived products exert a profound influence on the early recruitment of lymphocytes that may significantly influence the genesis of the adaptive immune response.

van den Broek, A. H. M., et al. *Veterinary Immunology and Immunopathology* 105 (2005) 141-50.

The effects of the potent anti-inflammatory drug, Cyclosporin A on the pathology of sheep scab was investigated. Following challenge with *Psoroptes ovis*, there is a rapid (within 24 h) inflammatory influx of eosinophils and apoptosis of the keratinocytes at the site of infection. In order to investigate whether these inflammatory reactions are important in the maintenance of mite infection, a group of animals were treated daily after the establishment of infection with the Cyclosporin A. The course of infection was monitored by determining the lesion area and mite numbers, systemic antibody and blood eosinophils, as well as the inflammatory cells and T cell sub-populations within the lesion throughout the 6-week duration of the experiment. These parameters were compared with those in a similar infected control (non-treated) group. In control infected animals, the lesion area and mite numbers increased steadily throughout the 6-week period. In contrast, lesion area and mite numbers were severely depressed in the group which received Cyclosporin A. Local and systemic eosinophils, and systemic antibody were also significantly reduced in the drug treated animals, compared to controls. Surprisingly however, the number of lesional pan T cells, T helper cells, gammadeltaT cells and dendritic cells

in Cyclosporin A treated animals were either the same, or significantly ( $P < 0.05$ ) enhanced when compared to the control infected animals at the termination of the experiment.

Huntley John F; et al. *Veterinary parasitology*. 127 (2005) 323-32

The costs of three major endemic sheep diseases in Great Britain, gastro-intestinal (GI) parasites, footrot and scab, were estimated and compared with costs for other diseases from another study. Disease costs include lost performance, preventive measures and treatment of affected animals. The most costly disease, of those studied, for the British sheep industry is infestation with GI parasites, with estimated annual costs of pound 84 million. Annual costs for the other two diseases are pound 24 million for footrot and pound 8 million for sheep scab. This compares with literature estimates of pound 20 million for Chlamydial abortions and pound 12 million for toxoplasmosis. For sheep scab most costs are for preventive measures, therefore, short of eradication, a reduction in incidence will have a limited effect on costs. For GI parasites, costs are linearly related to the severity of the infestation and a reduction of the disease will have a proportional effect on the costs to the industry. For footrot about half the costs are for preventive measures, the other half is for lost production and treatment. A reduction in the incidence of footrot has a proportional effect on the pound 10 million associated with loss of production and treatment of infected animals. It is concluded that gastro-intestinal parasites and footrot are two sheep diseases in Britain for which a reduction of severity or incidence will have a large impact on costs of production.

Nieuwhof, G.J. Bishop, S.C. *Animal science : An International Journal of Fundamental and Applied Research* 81(2005) 23-29.

#### Chewing Lice (*Bovicola ovis*)

No publications in 2005

#### Blowfly Strike

A study was carried out in Hungary to assess the efficacy of entomopathogenic nematodes to control L<sub>2</sub> larvae of the sheep blowfly, *Lucilia sericata*. The following nematode species were assessed: 12 strains of *Heterorhabditis bacteriophora*, 5 strains of *S feltiae* and 1 strain each of , *Steinernema intermedia*, *S. glasseri*, *S. anomaly* and *S. riobrave*. No species or strain tested showed larvicidal activity at 37°C. At lower temperatures (20°C - 25°C) only strain HU 1, 22 and IS 6 of *S feltiae* demonstrated activity. Parasitic forms of HU 1 and 22 could be detected in dead larvae of *L sericata*. Strain IS 6 penetrated and killed fly larvae, but only adult forms of the nematode occurred in cadavers.

Toth, E., et al. *Acta Veterinaria Hungarica* 53 (2005) 65 – 71.

#### **Ectoparasites of Goats**

Adult biting lice *Damalinia limbata* were most numerous on Angora goats in southwestern Free State Province in the summer (from November to May) with the lowest numbers during the winter (August). The largest proportion of adult lice were on the ventral surface during the winter, when populations were at their lowest. Infestations did not affect the body weight of the goats but adversely affected both the quality and quantity of the mohair produced. A single treatment of deltamethrin,

applied as a pour-on along the backline, effectively controlled infestation and significantly increased mohair production compared to untreated goats. Deltamethrin sprayed along the sides of the animals was equally effective in controlling infestations.

Brown, L., van der Linde, et al. Journal of the South African Veterinary Association. 76 (2005), 74 – 78.

## **Ectoparasites of Camelids**

### Chorioptic Mange

The efficacy of eprinomectin versus ivermectin for the control of natural chorioptic mange of alpacas has been described in two studies. Study 1: a single-centre, randomised, treatment-controlled, blinded field trial and Study 2: a single-centre, open, un-controlled field trial. Thirty alpacas, all positive for *Chorioptes*, were randomly allocated to two treatment groups in Study 1. Group A received a single topical administration of a 0.5% formulation of eprinomectin at the dose rate of 500µg/kg. Group B received three subcutaneous administrations at 14 days interval of a 1% formulation of ivermectin at the dose rate of 400µg/kg. Response to treatment was assessed by periodic mite count, and skin lesions scored. In Study 2, one group of 19 alpacas received four administrations at weekly intervals of topical eprinomectin at the dose rate of 500µg/kg, and response to treatment was monitored by mite counts. No localised or systemic side effects were observed in either trial. There was a statistically significant decrease in mite counts on day 7 ( $P < 0.001$ ) within treatment Groups A and B of Study 1, but mite counts increased again on day 14 and remained high for the duration of the trial in both treatment groups. On day 14 of Study 2, there was a statistically significant reduction in mite counts ( $P < 0.008$ ) and the mite counts remained very low throughout the remainder of the study. The eprinomectin protocol employed in Study 2, consisting of four weekly topical administrations at the dose rate of 500µg/kg of body weight, proved highly effective at reducing the *Chorioptes* burden in alpacas.

D'Alterio G L; et al. Veterinary Parasitology 130 (2005) 267-275.

A study aiming to determine the prevalence of *Chorioptes* infestations in UK alpacas (*Lama pacos*) was carried out. A total of 209 alpaca in nine units in the south-west of England were included in the study. Every alpaca on the unit was clinically examined for the presence of skin lesions. All alpaca presenting with signs of skin disease, as well as approximately one in five clinically healthy, randomly selected, in-contact alpacas were included in the sampled population ( $n = 83$ ). Superficial skin scrapings were taken from each animal included in the sampled population from six different sites, in addition a dry swab was taken from the ear canal. Of the 209 alpaca examined, 47 (47/209; 22.5%) showed signs of skin disease, ranging from mild alopecia, thickening, crusting and scaling of the skin of the pinnae, to severe and similar diffuse lesions affecting mostly ears, axilla, face and dorsum. Of the sampled population, 33/83 (39.8%) were positive for *Chorioptes*. Cumulatively, in 29 out of 33 positive cases (87.9%) *Chorioptes* were detected in scrapings taken from the forefoot and/or the axilla. Thirteen out of the 47 alpacas affected by skin lesions (27.7%) were concurrently positive for *Chorioptes* sp. mite, 20/36 (55%) un-affected sampled alpaca were positive for the mite and 34/47 affected alpacas (72.3%) presented skin lesions but were negative for *Chorioptes* sp. mite. Statistical test showed that affected animals tended not to be positive for the mite whilst un-affected animals tended to be positive for the mite. Additionally, there was a highly significant association between lesions, age and mite, in that an increase in the presence of

skin lesions and a decrease in the presence of mites with increasing age was observed. *Chorioptes* have been previously observed in the llama and the alpaca, but chorioptic mange was considered a rare condition in both host species. Findings from the present study indicate high prevalence of both the mite infestation and related clinical signs in alpaca in the south-west of England.

D' Alterio, G. L., et al. *Small Ruminant Research* 57 ( 2005 ) 221-228

## **Ectoparasites of Poultry**

Red mite continues to plague egg producers with over 80% of egg producers experiencing the parasite. Heavy infestations can reduce egg yolk quality, reduce egg output, and eggs speckled with crushed mites, blood and mite faeces. Birds will avoid heavily infested nest boxes and instead lay on the floor. The average cost of infestation exceeding £20,000.

Eades, P Right planning helps to banish red mite. *Poultry World*. 159 (2005), 28.

Results of a cross sectional postal survey of poultry producers within England to gain information on the prevalence and perceived importance of red mites was published. Participants were also requested to submit samples for in vitro acaricide testing.

In total 43 questionnaires were returned with a high percentage, 55% kept under free range conditions. The results indicated that 60% of layers, 30% of parent birds and <10 of fancy fowl were reported as infested with the majority of participants perceiving mites as a major problem in egg laying birds. The in vitro tests indicate that while carbamates appear effective, resistance to pyrethroids is common.

The study population is unlikely to be representative of the poultry industry in England and the high percentage of free range flocks may skew the prevalence figures. The figures produced though may be an under representation of true prevalence as they are based on farmer perception.

Fiddes, M. D., et al. *Veterinary Record* 157 (2005) 233-235.

Red mite infestations are greater in barn or free range systems as opposed to cage systems, since a greater number of hiding places can be sought. The problem will be amplified by the impending EU ban on battery cage production in 2012.

The immunological response of humoral antibodies to naturally occurring mite antigens using ELISA and SDS-PAGE. Antibodies derived from egg yolk and blood sera collected from commercial laying farms across the UK with varying levels of red mite infestation and using different production systems (caged, barn and free range). Mites were trapped and counted periodically so as to follow population dynamics over a flock lifespan in conjunction with a series of production measures (eggs produced per week, mortality and temperature). Infested free range birds mounted an immune response to red mite which was significantly higher compared to those kept by cage or barn systems. A higher mortality of free range birds could be due in part to blood loss, since infestation by red mite leads to hens becoming anaemic. There was a significant relationship between red mite population and mortality of hens ( $p < 0.05$ ), demonstrating that an increased red mite burden leads to a rise in total bird mortality, confirming the real economic and welfare consequences of predation by this parasite. Cited authors that red mite infestations could increase mortality by between 4% and 50% and reduced egg production by as much as 20%.

Arkle, S., Guy, J and Sparagano, O *Epidemiologie et Sante Animale*. 48 (2005) 15-19.

The effects of *D gallinae* and *Ascaridia galli* on the behaviour and health of laying hens was investigated. Six groups of 15 pullets were kept in indoor pens from 18 weeks of age. Two groups were artificially infected with *D gallinae*, two with *A galli* and two kept as uninfected controls. The hens were observed for behavioural reactions and physiological changes (weight and various blood variables) to the parasitic infections.

Infections of *D gallinae* resulted in reduced weight gain, anaemia and even death of some hens. Behavioural changes were also observed, as the mite-infected hens showed higher self grooming and head scratching both night and day. *A galli* resulted in a lower weight gain but no significant changes in blood variables or behavioural activities.

Kilpinen, O., et al. British Poultry Science 46 (2005) 26 – 34.

The potential of neem (*Azadirachta indica*) oil to control *Dermanyssus gallinae* was investigated. *In vitro* tests were performed to determine the optimum formulation. Cardboard traps containing 20% neem oil were placed at the mite aggregation sites, out of reach of hens, in a floor system for layers containing approximately 2400 birds. Treated traps were replaced every week for four weeks. Throughout the study the parasite population was monitored by collections of mites with untreated plastic traps. A 92% reduction in *D gallinae* was recorded.

Lundh, J., et al. Veterinary Parasitology. 130(2005) 337 – 342.

## TICK BORNE DISEASES (TBD)

Geographic information systems (GIS) and remote sensing (RS) are increasingly being used to determine the landscape predictors of disease risk. Many aspects of tick ecology and tick borne disease (TBD) epidemiology have been addressed using GIS/RS enabling the prediction of potential disease outbreaks and subsequent set up of intervention programmes. Daniel M et al Parasitology 129: (2004), S329 – S352, describe GIS systems, their fundamental components, technologies and their application to the study of TBDs.

A survey was undertaken of fox ticks in Hungary by collection of 2472 ticks from the carcasses of 346 foxes between January 2002 and June 2004. The results were compared with a 1950s study which examined 15000 ticks. In the former, 19 and in the later, 5 species were collected. Comparisons between *D. reticulatus* and *I. ricinus* were made and an increase in spatial distribution for *D. reticulatus* was reported which is likely to explain the increase in *Babesia canis* seen in Hungary. *I ricinus* was the most common tick species found and the present study mirrored the results of the previous study. However, the authors stated that moderate alterations in spatial patterns could not be dismissed especially as there had been changes in human tick-borne encephalitis which is a *I ricinus* borne disease. The findings of the study when taken together with background data on the emergence of tick borne disease in Europe supports a change in spatial distribution of ticks. The causes may be multifactorial but are likely to include global warming, change in use of land (reforestation) change in use of chemicals and other factors. The authors call for increased research in this field.

Sreter, T., et al. Veterinary Parasitology 128 (2005): 347-51.

## Tick borne disease In Dogs

It appears as though the northward march of canine babesiosis in Europe continues. The first recorded outbreaks of autochthonous canine babesiosis due to *Babesia canis* occurred in the spring and autumn of 2004 in the Netherlands affecting 23. Nineteen of these animals recovered whereas 4 died. None of the dogs had travelled and adult *Dermacentor reticulatus* ticks, a known vector of *B. canis*, collected from these dogs indicate that the disease may become established  
Matjila TP et al Veterinary Parasitology 131 (2005) 23-29.

*D. reticulatus* is sporadically reported from cattle, sheep and dogs in west Wales and south west England whereas *Rhipicephalus sanguineus*, another vector of canine babesiosis, has been found in infestations of domestic premises and quarantine kennels in UK. Since the introduction of the PETS scheme in 2000, cases of clinical babesiosis in dogs returning from overseas travel, some still carrying *R. sanguineus* ticks, have been reported by UK veterinary surgeons  
Smith K (2000) Vet Rec 147(2000) 279 –280, Perkins SCB Vet Rec 147(2000) 460.

Bremer WG et al Veterinary Parasitology 131(2005) 95-105 demonstrated that naïve male *Rhipicephalus sanguineus*, experimentally fed on *Ehrlichia canis* infected dogs, could feed again and transmit the rickettsia following mechanical transfer to susceptible dogs . Transtadial transmission of the organism from nymph to adult was also reported. Viable *R. sanguineus* ticks have been recovered from dogs entering UK from overseas destinations despite reported acaricide treatment. The evidence that male *R. sanguineus* can take multiple feeds and transmit tick borne pathogens from dog to dog may therefore be an important consideration for the risk of canine tick borne disease in this country.

A new piroplasm of dogs has been described from Brazil. Originally named *Rangelia vitalli*, the organism causes a condition known locally as nambiuvu (bloody ears) characterised by anaemia, jaundice, fever, splenomegaly, haemorrhage in the gastro-intestinal tract and persistent bleeding from the nose, oral cavity and outer ear surface. Parasites could be detected in stained bone marrow smears and from the cytoplasm of capillary endothelial cells but not in blood smears and ultrastructural studies showed an apical complex. The organism was positive by both in-situ hybridisation and immunohistochemistry for *Babesia microti* and has been placed in the Phylum Apicomplexa, order Piroplasmida. *R. sanguineus* ticks were recovered from infected dogs in urban areas whereas *Amblyomma aureolatum* ticks were found on dogs in rural areas.

Lorretti AP & Barros SS Veterinary Parasitology 134 (2005) 193 – 213

## Tick borne diseases in VIDA reports for 2005.

VIDA reports for the second two quarters of 2005 describe anecdotal evidence from veterinary practitioners and farmers of increased tick numbers and associated diseases in cattle. The number of babesiosis and louping ill diagnoses also increased during 2005 with bovine babesiosis being recorded for the first time (presumably within the history of VLA) in Gloucestershire and Lancashire.

An outbreak of disease, associated with infestation by the tick *Haemaphysalis punctata*, was described in a group of 60 sheep grazing rough grassland in north Kent. More than 25 deaths occurred in the group which was part of a 900 ewe flock, however only the ewes grazing one pasture were affected. On post mortem examination, widespread subcutaneous oedema especially on the lips, tongue,

eyelids, conjunctivae and petechial haemorrhages of the oral mucosa was noted. Examination of stained blood smears from moribund lambs and random blood samples taken from ewes revealed significant haemolytic anaemia and anaplasmod inclusions in erythrocytes. Further tests on blood samples from the sheep using PCR and reverse line blot (RLB) at the University of Utrecht, The Netherlands demonstrated the presence of a *Babesia* sp, a *Theileria* species similar to *Theileria* sp (China) and *Theileria* sp OT1 (Spain), and an *Anaplasma* / *Ehrlichia* sp other than *Anaplasma marginale*, *A.centrale*, *A.Ovis* and *A.phagocytophila*. Further work is necessary to type these three organisms to species level.

Prior to the application of molecular phylogenetics to the speciation of blood parasites, *Babesia motasi*, *Theileria recondita* and *Ehrlichia* (*Anaplasma*) *phagocytophila* were recognised tick borne pathogens of sheep in UK. From the work carried out so far on this disease incident, it appears as though an *Ehrlichia* / *Anaplasma* species may be identified which has not been recorded in the UK until this time.

## ***Fasciola hepatica***

### **Molecular Biology and therapeutics**

Ian Fairweather of the Queens University, Belfast, in collaboration with a group in Argentina, produced a paper on possible reasons for resistance to the commonly used flukicide triclabendazole (TCBZ). The concentration of the drug and its metabolites crossing the tegument of the parasite were measured by high performance liquid chromatography (HPLC). There was a significant difference in the concentration of the drugs and its metabolites within resistant strains of *Fasciola hepatica*. Altered drug influx - efflux and the enhanced capacity to metabolise TCBZ, identified in resistant liver flukes, may account for the development of resistance. Alvarez LI, et al. Parasitology 131(2005):501-10

A second paper written by Ian Fairweather and colleagues concerned ultra structure observations of the parasite by electron microscopy after incubation with the flukicide clorsulon. The experimental observations supported the view that uptake of this drug was by oral means rather than trans tegumental as with triclabendazole. A further paper, from this group, detailed the changes in structure of the tegument and gut of *Fasciola hepatica* in response to incubation with clorsulon. Again the data supported oral entry of the drug bound to red blood cells.

Meaney M, et al. Parasitol Res. 95(2005):201-12

Meaney M, et al. Parasitol Res.;95(2005):117-28.

A paper by Dutch workers described a lack of reversion to susceptibility to TCBZ in *F. hepatica*. On a farm where TCBZ resistance had been confirmed in sheep, and treatment with a different flukicide had been given, TCBZ resistance was still found three years later.

Borgsteede FH, et al.. Vet Rec. 156(2005):350-351.

### **Diagnostics**

A group at the Liverpool School of Tropical Medicine published two papers. The development of an antibody ELISA was compared to a commercially available

product from Bio-X. There was good agreement between the two tests when tested on 258 sera collected from cattle sampled in Cheshire and west Wales.

In the second paper the development of a bulk tank ELISA for fluke specific antibody was described. This was used to measure the prevalence of infection in dairy herds in England and Wales. There was an estimated 48% of herds in England infected, and 86% of herds in Wales.

Salimi-Bejestani MR, et al. *Res Vet Sci.*;78 (2005) 177-81.

Salimi-Bejestani MR, et al. *Vet Rec.*156(2005) 729-31.

## **Epidemiology**

A paper produced by a group in Switzerland calculated the estimated financial loss due to bovine fasciolosis in cattle in Switzerland. Financial loss was reckoned to be due to reduced milk yield and fertility and reduced weight gain of animals. The statistical analysis estimated the loss to Swiss cattle at 299 euros per infected animal.

Schweizer G, et al. *Vet Rec.*;157(2005):188-93.

A further paper from a group in Brazil described the prevalence of natural infection in a dairy herd of 44 cows in a region of Brazil over a 12 month period. Cows excreted eggs throughout the 12 month period of the study and grazing calves began to excrete eggs from the age of 4 months onwards. During the study, faecal samples were taken from other farms in the area, approximately 11% of these samples were found to be positive for fluke eggs. The region of Brazil concerned was regarded as an enzootic area for the parasite due to the climate being suitable for the intermediate snail host *Lymnaea columella*.

Faria,-R-N; et al. *Revue-de-Medecine-Veterinaire.* 156(2005): 85-86

Collaboration between the Liverpool School of Tropical Medicine and the VLA produced two papers on the prevalence of liver fluke infection in East Anglia. The emergence of fasciolosis in this region was attributed to favourable weather conditions for the intermediate snail host in the months preceding the survey. Also the influx of sheep from other endemic of the United Kingdom into East Anglia, and the development of environmentally sensitive areas favoured the propagation of the intermediate snail host.

Salimi-Bejestani MR, et al. *Vet Rec.*;156(2005):729-31.

Pritchard GC, et al. *Vet Rec.* 157(2005):578-82

## **Molecular Biology**

A group in China investigated cellular responses to experimental infection in sheep with *Fasciola gigantica* and *Fasciola hepatica*. Sheep were more susceptible to natural infection with *Fasciola hepatica* and they produced a more intense cellular response to the parasite *Fasciola gigantica*.

Zhang WY, et al. *Exp Parasitol.*;111(2005):154-9.

## **Zoonoses**

*Fasciola hepatica* infection is an important zoonosis in South America. A group in Spain used GIS to assess the risk of zoonotic infection in the South American Andes region. This region included Peru, Bolivia and Chile, and enabled the development of a spatial and temporal epidemiological model to map the disease in these infected areas.

A further paper by a group in Spain considered the epidemiology of fasciolosis in humans in endemic areas. A global analysis of the distribution of human cases showed that correlation between animal and human infection only appeared at a basic level. Human fasciolosis presented a range of epidemiological characteristics related to a wide diversity of environments. Control measures should therefore consider results of eco epidemiological studies undertaken in endemic areas.

A review article on human trematodiasis considered infection with a number of different trematode parasites. Infection was mainly related to ingestion of raw fish containing parasite metacercariae. The expansion of aquaculture and production of freshwater fish, particularly in south east Asia could pose a significant threat of trematodiasis in these regions. This threat does not include *F. hepatica*, but *F. hepatica* was mentioned in relation to consumption of aquatic plants, and contaminated water, which was surprising. The trematode parasite *Pseudamphistomum truncatum* recently described by Vic Simpson was not mentioned in this review.

Keiser Jennifer. Biosis No.: 200510337104 Emerging foodborne trematodiasis. Fuentes MV, et al. Parasitologia. 47(2005):151-6

## PARASITIC GASTRO-ENTERITIS

### Anthelmintics

#### New anthelmintics

Bayer announced the launch of a new novel anthelmintic, a cyclooctadepsipeptide, at the WAAVP conference in 2005. The drug is emodepside and is currently only available in combination with praziquantel as a spot on preparation for cats (Profender). This class of anthelmintics is originally derived from a fungus that belongs to the micro flora of the leaves of *Camellia japonica*. They are effective against a variety of gastro-intestinal nematodes in poultry, dogs, horses and ruminants as well as cats and also *Dictyocaulus viviparus* and *Trichinella spiralis* larvae in muscles. They act by binding to pre-synaptic latrophilin receptors, which lead, by an unknown pathway, to flaccid paralysis of pharynx and somatic musculature in nematodes.

Harder, A. et al. Parasitology Research 97 (2005) S1-S10.

The company says they are looking at launching the product in other species in the future.

A paper into chemicals related to emodepside, cyclohexadepsipeptides was published. They showed strong in vivo activity against *Haemonchus contortus* in sheep.

Jeschke P; et al Parasitology research 97 (2005) Suppl 1 pS17-21.

Another group of chemicals, arylquinolines, have been identified with potent activity against *H. contortus*, with LD99 values of the same order of magnitude as levamisole. These are also active against levamisole-, ivermectin- and thiabendazole-resistant strains of *H. contortus*.

Rossiter S. et al; Bioorganic & medicinal chemistry letters 15 (2005) 4806-8.

## Studies into existing anthelmintics

### Cattle

While several in vitro studies have shown that the anthelmintic ivermectin inhibits feeding by parasites, the relevance of this in vivo has not been demonstrated. One paper failed to show this effect in ivermectin treated sheep. Sheriff, J-C; et al. *Veterinary-Parasitology*; 128(2005): 341-346

Studies into the effect of eprinomectin on earthworms concluded that treatment of cattle with EPRINEX (eprinomectin) Pour-On for Beef and Dairy Cattle did not affect feeding or weight gain of the earthworms.

Halley Bruce A; et al *Veterinary parasitology* 128 (2005) 109-14.

### Goats

An experiment comparing the efficacy of ivermectin in goats given by oral or subcutaneous routes was published. A similar efficacy against *T. colubriformis* after subcutaneous or per os administration was seen. However, the lower ivermectin levels in tissues after per os administration suggest that the lasting of efficacy may be shortened after per os compared to subcutaneous administration especially in animals with poor body condition in pasture where re-infection occurs quickly after anthelmintic treatment.

Lespine, A; et al. *Veterinary-Parasitology*. 128(2005) 251-260

A study of the persistence of the efficacy of an injectable formulation of doramectin (Dectomax) against *H. contortus* in goats showed that the injectable formulation of doramectin was effective against experimental haemonchosis in goats for 14 to 25 days after treatment. Molina, J-M; et al. *Veterinary-Record*. 156 (2005): 448-450

### Camelids

Gastrointestinal parasites are a major clinical and economical threat to New World camelids throughout the world. Since there are no anthelmintics approved for use in these, there is only limited information about the efficacy and safety of these products. Both for the llamas and the alpacas, naturally infested with *Trichostrongylus* spp. and *Oesophagostomum* spp., there was a 100% reduction in faecal egg output for at least 3 weeks when treated with an injectable ivermectin. None of the animals showed adverse reactions to the ivermectin treatment.

Geurden, T; Hemelrijk, K-van. *Small-Ruminant-Research*. 58(2005): 71-73

## **Gastro-intestinal parasites in sheep**

Between 1999 and 2003, studies were done at Utrecht University, Netherlands, on the population dynamics of gastrointestinal nematodes and the potential to use evasive grazing for the control of nematode infections in small ruminants. On most pastures grazed in May and June it took at least 3 weeks before high pasture infectivity levels for *H. contortus* developed while it took at least 2 weeks on pastures grazed in July, August and September. Occasionally, larvae emerged earlier on pasture when high temperatures coincided with rain. Pasture infectivity levels for *H. contortus* subsequently increased and the highest levels were found between 5 and 9 weeks on pastures grazed in May-June and between 3 and 9 weeks on pastures

grazed in July, August and September. Pasture infectivity usually had decreased again to low levels after approximately 3 months. Larvae of the other trichostrongylids emerged later on pasture. However, patterns of *Teladorsagia circumcincta*, *Trichostrongylus* spp. and *Cooperia curticei* were basically similar to *H. contortus*. *Strongyloides papillosus* larvae emerge within 2 weeks on pasture and survival is short. On the other hand *Nematodirus* larvae took a lot longer to emerge on pasture than the other trichostrongylids. The results imply that only on a small proportion of farms (mixed dairy cattle/sheep farms; some organic dairy goat farms) evasive grazing can be recommended as the only control measure for parasitic gastro-enteritis. However, the present data offer possibilities to combine evasive grazing with other methods in an integrated control scheme.  
Eysker M; et al. *Veterinary parasitology* 129 (2005) 95-104.

The summer of 2003 (June-August) was unusually warm and dry in the Netherlands. As a result, the patterns of gastrointestinal nematode infections deviated from those observed in more average years. The proportion of eggs that developed to infective larvae was far lower than normal in July-August. On the other hand, survival of larvae that had developed before the middle of July was not affected compared to other years. In fact, severe haemonchosis was observed in (tracer) lambs grazed at the end of July on pastures that had been contaminated from 26-05 to 16-06 and from 16-06 to 07-07. Moreover, tracer lambs grazing in September on some of these plots still acquired large *H. contortus* burdens. That may have consequences for the application of evasive grazing as a control option in that suppression of adult burdens might still be necessary, through a limited use of anthelmintics or through alternative deworming strategies.

Eysker, -M; et al. *Veterinary-Parasitology*. 133(2005) 313-321

Nematode parasites of livestock have to complete both a parasitic phase inside the animal, as well as a free-living phase on pasture. The long, cold winter conditions on pasture and the normal practice of housing sheep in Sweden mean that parasites of sheep flocks in this country have evolved strategies to cope with this situation to ensure their between-year survival and transmission. It was concluded that under Swedish sheep farming conditions, *H. contortus* had evolved to survive the long, cold winter entirely within the host as the arrested larval stage, relying on the lambing ewe to complete its life cycle. The periparturient relaxation of resistance in the ewes triggered the resumption of development to the adult egg-laying parasites to result in pasture contamination and the completion of just one parasite generation/year. In contrast, *T. circumcincta* could survive well overwinter, both on pasture and within the host.

Waller, -P-J; et al. *Svensk-Veterinartidning*. 57(2005): 11-20

A study investigated the importance of suckling for the resistance and/or resilience of very young lambs to *T. circumcincta* nematode infection. The study did not show any advantage of suckling while grazing for lambs' resistance or resilience to larval intake within the 12-week post lambing period.

Iposu, -S-O; et al. *Proceedings-of-the-New-Zealand-Society-of-Animal-Production*.; 65 (2005) 182-185.

Using genetic analysis, a poster presented at the WAAVP conference concluded that *T. circumcincta* and *Ostertagia trifurcata* are variants of the same species, therefore *O. trifurcata* should be called *T. trifurcata*. (abstract D67, proceedings of the 20<sup>th</sup> WAAVP conference, Christchurch, New Zealand October 2005)

## Monitoring worm egg counts

An evaluation of the portable on-farm faecal worm egg counting system called Fecpak in the UK was published in 2005. Six intensive lowland sheep farms in Northern Ireland, UK were used and in-depth training given to the farmers at the start. Faecal egg counts (FECs) were monitored for *Ostertagia*, *Teladorsagia*, *Trichostrongylus*, *Cooperia*, *Haemonchus* and *Nematodirus* spp. ova using the Fecpak system and the standard McMaster technique. The McMaster technique was performed in the laboratory while the Fecpak technique was performed in the laboratory and by the farmer. Good correlation between laboratory McMaster and laboratory Fecpak results were achieved. However, there was a highly significant difference in strongyle FECs between the laboratory Fecpak and Fecpak done by farmers, where the farmers always overestimated egg counts. *Strongyloides* sp, coccidia oocysts, air bubbles, pollen or debris could have contributed to the overestimate by farmers. These results suggest that the on-farm Fecpak system is an accurate and reliable means of performing FECs when done by skilled, experienced operators. However, flock owners who were trained to use this system found it difficult to obtain an accurate worm egg count.

McCoy M A; et al. *Veterinary record* 156 (2005) p21-3 ,

Using field samples and simulated egg counts, the validation of the composite worm egg count used by the VLA was presented in another paper published in 2005. Using a negative binomial distribution model for aggregation, and a Poisson model for egg distribution within faecal suspensions, the method chosen was shown to produce an adequate estimate of group mean where parasite aggregation is low e.g. a group of similar age of lambs. However, extra care is needed in situations where high levels parasite aggregation might be expected.

Morgan, E.R. et al. *Veterinary parasitology*. 131(2005) 79-87.

## Anthelmintic resistance in sheep in UK

Several general reviews on anthelmintic resistance in sheep in the UK were published in 2005. In one it states that dilution of resistant parasites with susceptible ones is only at the preliminary research stage and the application of non-chemical methods of control to delay resistance is not yet a practical option. (Coles G C. *Research in veterinary science* 78 (2005) p99-108

Other reviews published were Taylor, M. *Veterinary Times* 35 (2005 ) p.14-16 and Mitchell, S. *Government veterinary journal* 15 (2005) 24-29.

The failure of moxidectin to control benzimidazole-, levamisole- and ivermectin-resistant *T. circumcincta* in a sheep flock in Scotland was documented. Ewes were dosed after lambing with the aim of controlling their periparturient rise in faecal egg output and lambs were dosed at six-week intervals throughout the summer. This regimen failed to suppress the establishment of significant numbers of infective helminth larvae on the pasture, resulting in unsatisfactory lamb production. Oral dosing with moxidectin was effective in removing adult female burdens of ivermectin-resistant *T. circumcincta*, but the effect of the drug did not persist against the resistant helminth population. (Sargison, -N-D; et al. *Veterinary-Record*. 156 (2005) 105-109

Further studies on the same isolate looked at the effect of anthelmintics, singly or in combination against the larval stages. The results illustrate that combination treatments showed improved efficacies against the juvenile population compared to individually administered treatments but that these improvements were not wholly effective. Moxidectin was the only treatment that was over 95% effective, though caution should be noted when advising its use as 3% of the infection still survived this treatment. Treatments directed at juvenile stages of this strain were less effective, with the exception of ivermectin, compared to a similar trial where the same treatments were directed against a predominantly adult population. These findings suggest that, on the whole, the selection processes for anthelmintic resistance (AR) may occur at an early stage of development within the parasites. Bartley D.J.; et al., *Veterinary Parasitology* 134 (2005) 261-266.

Attempts to select for ivermectin resistance in a susceptible isolate of *H. contortus* was published. Lambs infected with two isolates, one British and one American, of *H. contortus* were treated with increasing doses of ivermectin. Eggs from the highest dose that had not eliminated the infection were cultured and larvae used to infect another lamb. After three generations the *H. contortus* was resistant to 0.2 mg/kg ivermectin. The results stress the ease with which ivermectin resistance can be selected if high selection pressure is applied. Coles, -G-C; et al. *Veterinary-Parasitology*. 129(2005): 345-347.

The Moredun Institute in Scotland presented a poster at the WAAVP conference on the results of faecal egg count reduction tests carried out on ewes after treatment with an ivermectin in the peri-parturient period. Of 17 flocks with sufficient eggs to test, efficacy less than 95% was detected in 6 flocks. *T. circumcincta* was the predominant species. The implications are that ivermectin resistance is present in a larger number of flocks than thought. (abstract D8 Proceedings of the 20<sup>th</sup> WAAVP conference 2005)

### **Anthelmintic resistance in sheep worldwide**

A survey of the prevalence of emerging macrocyclic lactone resistance and of benzimidazole resistance in sheep nematodes on 30 commercial sheep farms in the lower North Island of New Zealand was published. 30 animals were randomly allocated to one of two equal-sized groups and treated with either half of the recommended dose rate of ivermectin (half of 0.2 mg/kg), or with the full recommended dose rate of oxfendazole (4.5 mg/kg). Faecal egg counts, accompanied by pooled larval cultures, were conducted on all samples at the time of treatment and 7-10 days later. Resistance, as indicated by a <95% faecal egg count reduction (FECR) in both instances, was found to oxfendazole on 13/30 (43%) farms and to a half dose of ivermectin on 12/36 (33%) properties. For oxfendazole, such resistance was found to involve all six nematode genera whereas for ivermectin it was almost entirely restricted to *Ostertagia* and *Cooperia* spp. infections. They also suggest that the half-dose ivermectin faecal egg count reduction test (FECRT) may offer some very practical benefits for parasite control by providing early warning of developing resistance to ML drenches and by signalling the possible imminent failure of these at their therapeutic dose rates. These results indicate that emerging macrocyclic lactone (ML) resistance may be more common on sheep farms in New Zealand than is generally realised. (Hughes P L; et al. *New Zealand veterinary journal* 2005 , 53 (1) p87-90) ,

This was supported by the results of a larger anthelmintic resistance survey of sheep flocks in New Zealand, which were presented at the WAAVP conference. Farms were randomly selected and had to have greater than 1000 sheep. The study was carried out by faecal egg count reduction tests (FECRT) and kits containing the anthelmintics under test were sent out. 6 groups of 10 animals were tested per farm and resistance detected when FEC was reduced by less than 95%. The results were

- Ivermectin resistance detected on 25% of farms
- Albendazole resistance detected on 41% of farms
- Levamisole resistance detected on 24% of farms
- Combination of albendazole and levamisole resistance detected on 7% of farms.

36% of sheep farms did not show resistance to any of the three groups of anthelmintics.

The authors also advocated the benefits of using combination products in New Zealand. A benzimidazole/levamisole product has 33% of the market share (and has been available for a long period). The survey showed that only 7% of farms had resistance to this combination, whereas ivermectins also have 33% of the market and 25% of farms showed resistance.

Work was also presented at the WAAVP conference into the selection pressure for anthelmintic resistance of a pre-lambing, long acting anthelmintic product. It showed that this was highly selective for resistance. The authors advocated that this should only be used when there were clear benefits and then to consider targeted use only. (abstract C1.1 Proceedings of the 20<sup>th</sup> WAAVP conference 2005)

Confirmation of resistance to ivermectin in *Cooperia curticei* in sheep using dose and slaughter trials in New Zealand was published. It showed that after treatment with ivermectin at the recommended dose rate, the populations of *T. circumcincta* and *C. curticei* were reduced by only 37% and 19%, respectively. This represents the first record of macrocyclic lactone (ML) resistance in *C. curticei* in sheep in New Zealand or elsewhere.

Hughes,-P-L; McKenna,-P-B. New-Zealand-Veterinary-Journal. 53(2005): 344-346

Studies into the time that ivermectin remained an effective drench on Australian sheep farms was studied. Using survival analysis and hazard ratios, the effect of reduced anthelmintic treatments, pasture management and expert advice from veterinary surgeons were all studied.

(Suter R J; et al. Preventive veterinary medicine 72 (2005) 311-322

### **Anthelmintic resistance tests-in vitro**

This report describes a new molecular method for the diagnosis of benzimidazole susceptibility or resistance in three main species of trichostrongylids of sheep (*Haemonchus contortus*, *Teladorsagia circumcincta* and *Trichostrongylus vitrinus*). This assay is based on the use of real time polymerase chain reaction (PCR) to detect mutations of residue 200 on isotype 1 of beta-tubulin. The technique allows calculation of the proportion of each allelic variant.

Alvarez-Sanchez M A et al. Veterinary parasitology 129 (2005) 291-8

A larval feeding assay for detection of nematode anthelmintic resistance to macrocyclic lactones and imidazothiazoles (levamisole) is described. The estimated concentration of anthelmintic required to inhibit larval feeding in 50% of L1's (IC50) that were resistant to either macrocyclic lactones or imidazothiazoles were significantly higher ( $P < \text{or} = 0.05$ ) than those of susceptible isolates. These results

suggest that this technique may provide an alternative in vitro to detect anthelmintic resistance.

Alvarez-Sanchez M A; et al. *Experimental parasitology* 110 (2005) 56-61.

However, another paper that studied the feeding of *Haemonchus contortus* in vivo, when exposed to ivermectin, did not show an inhibition in feeding when exposed to the drug.

Sheriff James C; et al. *Veterinary parasitology* 128 (2005) 341-6

### **Anthelmintic resistance tests-in vivo**

Two papers were published that looked at the mathematical alternatives of assessing anthelmintic resistance by way of faecal egg count reduction tests.

Torres-Acosta J F J; et al. *Veterinary parasitology* 134 (2005) 241-8

Torgerson P R; et al. *Veterinary parasitology* 128 (2005) 291-8

### **Biological control of gastro-intestinal parasites**

Studies are continuing into control of parasites in sheep using nematode trapping fungi. *Duddingtonia flagrans* has been the subject of most papers, but other fungi have been studied. The effectiveness shown has varied in the past and seems to depend in part on environmental conditions where used. All studies have involved daily feeding of the fungi. No commercial product is as yet available.

Studies on commercial sheep farms in Sweden showed the number of lambs that were marketed prior to the end of the grazing season was greater for the fungus treated group for each of the 3 years of study. Final weights of the remaining lambs at the end of each year were also consistently heavier and the numbers of lambs retained for finishing during winter were less in the fungus treated group compared with the control group.

Waller,-P-J; et al. *Svensk-Veterinartidning*. 57(2005) 11-19

Other papers include the nematode-trapping efficacy of two chlamydospore-forming fungi, *Arthrobotrys musiformis* and *Duddingtonia flagrans* against *H. contortus* in sheep.

Chauhan J B; et al. *Journal of helminthology* 79 (2005) 315-9 and

Graminha Erika B N; et al. *World Journal of Microbiology & Biotechnology* 21( 2005 ) 717-722

One study was also published into its use in goats and the optimum dose investigated. Paraud,-C; et al. *Veterinary-Research*. 36(2005) 157-166

A review of the subject and how it might be applied in the USA was published Soder,-K-J; Holden,-L-A *Professional-Animal-Scientist*. 21(2005) 30-37

*Bacillus thuringiensis* was also the subject of a paper on biological control of parasites. The in-vitro activity of the toxins against the larval stages of gastro-intestinal (GI) parasites was of a magnitude similar to or greater than that seen with the anthelmintic drugs thiabendazole and levamisole. However the need to protect the toxin from the acidic conditions of the sheep abomasum if it were to be administered per os as an anthelmintic would be necessary.

Kotze A C; et al. *International journal for parasitology* 35 (2005) 1013-22.

Work is continuing in the USA into the effects of copper oxide wire particles on gastro-intestinal parasites, particularly *H. contortus*. The safety of this approach with British breeds of sheep is not known.

Burke J M; et al. *Veterinary parasitology* 134 (2005) 141-6.

Burke J M; et al. *Veterinary parasitology* 131 (2005) 291-7

## **The use of alternative forages to control parasitism**

Studies in the past have shown that certain forages can reduce parasitic infection in sheep.

### Studies in sheep in the UK

A paper published in 2005 on the effect of forage legumes and anthelmintic treatment on the performance, nutritional status and nematode parasites of grazing lambs showed that legume forages have the potential to contribute to the control of abomasal but not small intestine nematode parasites in finishing lamb systems. Marley C L; et al. *Veterinary parasitology* 131 (2005) 267-82.

Another study in the UK to investigate the consequences of short-term grazing on bioactive forages on *T. circumcincta* infection in lambs was published in 2005. Chicory (*Cichorium intybus*), sulla (*Hedysarum coronarium*), lotus (*Lotus pedunculatus*), and the control grass/clover (*Lolium perenne/Trifolium repens*) were used as forage. Although faecal egg counts (FEC) or total egg output were similar among the groups, adult worm burdens at slaughter were significantly affected by forage treatment during a 2 week grazing period. Lambs grazing chicory had the lowest adult worm burdens and significantly lower numbers of male worms compared to those grazing on grass/clover. Overall, the results of the present study support the view that chicory can be a promising candidate species in pasture management practices to control *T. circumcincta* burdens.

Tzamaloukas,-O; et al. *International-Journal-for-Parasitology*. 35(2005): 329-335

### Studies in goats

Studies in goats have not been so numerous and yet the problem of multiple anthelmintic resistance in this host species has highlighted the need to reduce reliance on anthelmintics.

The effects of tannins on adult populations of *H. contortus*, *Trichostrongylus colubriformis* and *T. circumcincta* in goats are characterised mainly by a decrease in egg excretion without any significant changes in worm number. In contrast, the impact of tannins on *T. colubriformis* or *T. circumcincta* third-stage larvae (L3) is associated with a significant reduction in worm establishment. A paper published in 2005 failed however to demonstrate an effect on the establishment of *H. contortus* larvae with sainfoin hay or tannins extracted from quebracho.

Paolini,-V et al. *Veterinary-Journal*. 170(2005) 260-263

However a paper was published where the effects of consumption of sainfoin hay by goats on their parasite populations under natural conditions was studied. The results demonstrated that a repeated distribution of sainfoin hay to grazing goats might be beneficial in regard of pasture contamination and host resilience. They suggested that the administration of sainfoin hay might represent a valuable alternative and adjunct to reduce nematode infections in dairy goat flock.

### **Breeding for resistance**

A study into the selection of sheep on the basis of worm egg counts in Perendale lambs after weaning in New Zealand was published. It concluded that, there were unfavourable correlated responses to selection to reduce FEC, comprising lower weights, reduced fleece weights, and more dags.

Morris,-C-A; et al. New-Zealand-Journal-of-Agricultural-Research. 48(2005) 1-10

This result may be partly explained by the findings that there is a nutritional cost to the acquisition and maintenance of immunity to gastro-intestinal parasites.

One paper reported that the reduction in voluntary food intake and loss in performance in young sheep parasitised with *T. colubriformis* is caused by physiological signalling associated with the acquisition phase of the host immune response to infection, rather than simply the damage caused by the parasite.

Greer,-A-W; et al. Animal-Science 80(2005) 89-99

A subsequent paper showed similar findings with infection with *T. circumcincta*. They conclude that it would appear that the major contributor to reduced production in gastrointestinal nematode infections is the host immune response, rather than damage from the parasite per se.

Greer,-A-W; et al. Proceedings-of-the-New-Zealand-Society-of-Animal-Production. 65: (2005) 9-12

A paper at the WAAVP conference concluded that Merino sheep in Australia, which had been selected for resistance to *H. contortus*, had reduced weight gain and wool growth than non-selected sheep in the absence of *H. contortus* challenge. It is thought likely that metabolic repartitioning of nutrients from production towards gut immune responses occurs in resistant sheep.

(abstract L92 Proceedings of the 20<sup>th</sup> WAAVP conference 2005)

The importance of faecal moisture on faecal egg counts was the subject of a poster at the WAAVP conference 2005. Using chromic oxide particles to mimic trichostrongyle type eggs, it was advised that, particularly in the area of breeding for resistance, faecal egg counts are calculated per gram of dry faeces, or an adjustment factor is used, based on faecal consistency.

(abstract L98 WAAVP 20<sup>th</sup> International Conference, New Zealand, October 2005.)

### **Effect of feeding on immunity in sheep**

The importance of diet, in particular protein, on resistance to *T. circumcincta* infection in sheep has been shown in the past.

A paper published in 2005 looked at the effects of protein supply and reproductive status on circulating antibody responses and local inflammatory cell counts in parasitised sheep. It was thought that if breakdown of immunity has a nutritional basis, then protein scarcity would result in a breakdown of immunity to *T. circumcincta* in both periparturient and non-reproducing (barren) ewes. Faecal egg counts remained virtually zero in all barren ewes, whilst protein supplementation reduced faecal egg counts in the periparturient ewes during most of the periparturient period. Final worm burdens, taken at 6 weeks into lactation, were lower for the barren ewes than for the lactating ewes, whilst protein supplementation reduced worm burdens in the latter. It is likely that the combination of low protein requirements and

large body protein reserves did not result in breakdown of immunity to *T.circumcincta* for the barren ewes.

Houdijk,-J-G-M; et al. *Veterinary-Parasitology*. 129(2005) 105-117

Low protein diets were found to influence immune function in response to *T. circumcincta* and as a result resistant genotypes do not show any superiority in comparison with susceptible ones in studies with the Churra breed of sheep.

Martinez-Valladares,-M; et al. *Parasite-Immunology*. 27(2005) 219-225

### ***Ostertagia ostertagi* in adult dairy cows.**

There is a lot of research currently being carried out into the development and use of a bulk milk ELISA for detecting antibodies to *O. ostertagi*.

Assessment of the repeatability of a milk *Ostertagia ostertagi* ELISA and effects of sample preparation. Charlier Johannes et al. *Preventive Veterinary Medicine* 68 (2005) 277-288

Evaluation of the stability of *Ostertagia ostertagi* ELISA microtitre plates over time using cow milk samples. Sithole, F.; et al. *Veterinary Parasitology* 133 (2005) 329-337

One paper used this test to look at herd size and management factors associated with higher bulk milk ELISA OD ratios (ODR) in Belgium. Large sized herds had significantly lower ODRs as compared to medium or small sized herds. Herds with only dairy cows had lower ODRs than herds with both dairy and beef cows. An increased exposure to pasture of the cows was associated with higher ODRs. Later turnout on pasture and mowing were both significantly associated with lower ODRs. Cows that had a restricted grazing time per day tended to have lower ODR than cows that grazed 24 hours per day. An increased exposure to pasture of the heifers was significantly associated with higher ODRs. No associations were found between ODR and calf related management factors, anthelmintic treatment strategy; time of turn-in, rotational grazing type or stocking rate. Later turn-out on pasture, mowing and restricting the grazing time per day are factors that can be applied immediately on dairy farms to reduce economical losses due to gastrointestinal nematodes.

Charlier,-J; et al. *Veterinary-Parasitology*. 133(2005): 91-100

There is also a lot of work being carried out into the effects of eprinomectin on milk yield in dairy cows. The overall response to eprinomectin treatment in dairy cows in one paper included significant ( $P < 0.050$ ) increases in mean daily solids-corrected milk (SCM) yield following each of the three treatments, indicating a positive response to repeated treatments at several different stages of lactation. There were no significant differences in the overall percentages of fat, protein or lactose between control and treated groups. The differences in live weight were not significant. Faecal egg counts in control animals were low, in this paper, group arithmetic mean was a maximum of 6.8 epg

Gibb,-M-J; et al. *Veterinary-Parasitology* 133(2005) 79-90

The use of an indirect *Ostertagia ostertagi* ELISA to determine if it could predict milk production response after endectocide treatment at calving was studied in Canada. Pre-calving ODR showed a seasonal pattern. They were higher in the summer and autumn and lower during the winter months. Older animals had higher pre-calving ODR values compared with younger cows. Similarly, cows from semi-confined herds had higher parasite antibody levels compared with cows from confined herds. The endectocide treatment did not affect the milk production response in the overall study population. However, the interaction effect between treatment and pre-calving ODR

on milk production response after endectocide treatment was significant, with some evidence of positive treatment response in cows with an ODR>0.4.  
Sanchez,-J; et al. Veterinary-Parasitology. 130(2005) 115-124

Another paper states that in temperate climate regions, gastrointestinal nematodes are widespread in adult dairy cows, but until now there exists no reliable diagnostic tool that can identify herds where the infection interferes with productivity. The objective of one study was to investigate the relationships between levels of antibodies against *O. ostertagi* in bulk tank milk and milk production. Bulk tank milk samples of 2553 dairy herds were obtained in spring and 2104 of these herds were sampled a second time in autumn. The antibody levels against *O. ostertagi* were determined with a milk ELISA and test results were expressed as an optical density ratio (ODR). The effect of bulk tank milk ODR on three different production parameters, kg milk, % and kg fat, % and kg protein was assessed by a multivariable linear regression model on the herds for which production data were available. Significant negative relationships were found between ODR and milk yield. An increase in ODR<sub>spring</sub> and ODR<sub>autumn</sub> from the 25th to the 75th percentile of the available ODR data was associated with a drop in the annual milk yield of 1.1 kg/cow/day, respectively 0.9 kg/cow/day. When a herd's ODR increased between spring and autumn with 0.142, it produced on average 0.4 kg/cow/day less in September than in April, in comparison with herds where the ODR did not increase. A significant negative association was found between ODR<sub>autumn</sub> and % protein averaged over the period of a year. No significant associations were found between ODR and % fat averaged over the year. When protein and fat production of milk in September were expressed in kg an increase in ODR<sub>autumn</sub> from the 25th to the 75th percentile was associated with a decrease of 0.037 kg protein/cow/day and 0.042 kg fat/cow/day.

Charlier,-J; et al Veterinary-Parasitology. 129 (2005): 67-75

There would appear no doubt that anthelmintic treatment can improve milk yield of some dairy cattle. However, the advisability of advocating increased use of anthelmintics to do this, in the light of anthelmintic resistance is debatable.

### **Anthelmintic resistance in cattle**

Various papers have been published in 2005 looking at the effects of combinations of anthelmintics in cattle affected by ML resistant populations of *Cooperia* and *Haemonchus* spp. in South America. Varying efficacies were observed.

(Loveridge,-B; et al. A-Hora-Veterinaria. 25(2005): 18-20;

Rangel,-V-B; et al.Arquivo-Brasileiro-de-Medicina-Veterinaria-e-Zootecnia. 57(2005): 186-190.

Rodrigues,-D-C; et al. A-Hora-Veterinaria. 25(2005): 27-30

Results of a survey of beef herds in New Zealand by FECRT were presented at the WAAVP conference. Results were startling.

- Ivermectin resistance detected on 92% of farms

- Albendazole resistance detected on 76%

- Levamisole resistance detected on 8%

- 6% of herds showed no resistance to the three anthelmintic groups.

- Cooperia* spp. were the predominant resistant species found

(abstract C1.1.Proceedings of the 20<sup>th</sup> WAAVP conference, Christchurch, New Zealand. October 2005)

Cooperia spp. are the dose limiting parasite for ivermectins, i.e. are the most difficult to kill, so it might be expected to see resistance in this species first. They are not considered as pathogenic as e.g. Ostertagia spp, but the worry is that this might be the forerunner of resistance being detected in more pathogenic species. New Zealand appears to lead the world in incidence of anthelmintic resistance in cattle parasites with these results

## **Modelling--review**

Mathematical models require a fine balance between biological detail and mathematical tractability. Models can now accommodate much more biological complexity but, nevertheless, they focus on elucidation of principles rather than exact predictions. In this article, the advances made in population modelling of nematode parasites in the last 20 years are discussed.

Modelling nematode populations: 20 years of progress  
Cornell Stephen Trends in Parasitology 21 ( 2005 ) 542-545

Information on A computer model under development for predicting endoparasitic levels in sheep flocks in the UK was presented at the International Sheep veterinary society, and at the WAAVP meeting October 2005. The model is programmed to use epidemiological information for PGE nematodes and specific on farm data to produce the predicted values. On farm data includes flock size, worm populations, grazing movements, lambing dates and treatment dates.

A Computer Simulation Model for the Control of Parasitic Gastroenteritis in Sheep-(UK) (M. A. Taylor et al, 6<sup>th</sup> International Sheep vet Congress, Hersonissos, Crete, June 2005 )

## **Vaccines**

A review into the work on vaccines against veterinary helminths was published in 2005.

The majority of attempts to develop commercial vaccines for veterinary helminths have focussed on identifying protein antigens, which could be formulated as protective vaccines. Notable successes have been achieved for some cestode parasites, where recombinant proteins have been developed into highly effective vaccines. Although effective protection can also be obtained using some nematode proteins in their native forms, it has not yet been possible to formulate commercially successful vaccines for other helminth parasites of veterinary significance. In addition to identifying candidate protective antigen(s), an increased research effort is needed to develop appropriate strategies for the formulation and delivery of helminth vaccines. Hein W R ;Harrison G B L. Veterinary Parasitology 132 ( 2005), (Sp. Iss. SI) 217-222

## COCCIDIOSIS IN POULTRY

### Control

A paper "Guidelines for evaluating the efficacy and safety of live anticoccidial vaccines, and obtaining approval for their use in chickens and turkeys" (Chapman *et al*, Avian Pathology 34 (2005) 279-290) contains the first guidelines for coccidiosis vaccines, and will have a major impact for current and future vaccination research. This paper was also discussed at length at the 9<sup>th</sup> International Coccidiosis Conference in Iguassu Falls, Brazil in September 2005.

Vaccination continues to be the future for coccidiosis control and several different approaches have been reported. A Live attenuated vaccine (Paracox™) has been available for at least a decade in the UK, but new similar products are being developed worldwide. Kawazoe *et al* from the University of Sao Paulo, Brazil reported on the "Characterisation and histopathological observations of a selected Brazilian precocious line of *Eimeria acervulina*" (Veterinary Parasitology 131, (2005) 4-14), and Li *et al* from China reported on "Responses of chickens vaccinated with a live attenuated multi-valent ionophore-tolerant *Eimeria* vaccine" (Veterinary Parasitology 129 (2005) 179-186).

Two novel vaccination methods were also reported, one of which utilises a subunit vaccine ("Prevention of broiler chick coccidiosis using the inactivated subunit vaccine CoxAbic", Ziomko *et al*, Bull Vet Inst Pulawy 49, (2005) 299-302), and another using *In ovo* vaccination ("*In ovo* vaccination with the *Eimeria tenella* EtMIC2 gene induces protective immunity against coccidiosis", Ding *et al* Vaccine 23,(2005) 3733-3740). These two methods were also extensively reported at the International Coccidiosis Conference, (e.g. "Maternal protection against *Eimeria* challenge of CoxAbic vaccinated chickens", Finger and Michael page146 of Proceedings, and "*In ovo* and dietary modulation of host intestinal immunity and its subsequent effects on coccidiosis", Dalloul *et al*, page139).

Very few new anticoccidial drugs are being developed, but Ralph Marshall suggested that the use of carefully formulated herbal extracts traditionally used in Chinese medicine for over 4,000 years to treat malaria may have a place in coccidiosis control ("*Artemesia annua* – a potential anticoccidial?" Proceedings of WAAVP 20<sup>th</sup> International Conference, New Zealand, October 2005).

Another plant derived product was reported by Cepta Duffy *et al* ("Effects of Natustat™ supplementation on performance, feed efficiency and intestinal lesion scores in broiler chickens challenged with *Eimeria acervulina*, *Eimeria maxima* and *Eimeria tenella*", Veterinary Parasitology 130 (2005) 185-190). Further information was presented at the International Coccidiosis Conference, Brazil

### Concurrent infections

A major review paper by R B Williams highlighted a growing problem for broiler producers since the withdrawal of many anticoccidial drugs. "Intercurrent coccidiosis and necrotic enteritis of chickens: rational, integrated disease management by maintenance of gut integrity" highlighted the importance of disease control by the use of nutrition as well as anticoccidials or vaccines. Avian Pathology 34(2005), 159-180.

Necrotic enteritis and coccidiosis was also discussed in the Indian Veterinary Journal by Sreedevi and Prasad who confirmed both *Eimeria necatrix* and *Clostridium perfringens* infections in 12 week old growers examined *post mortem*. "Concurrent infection of coccidiosis and necrotic enteritis in growers", Indian Vet J 82 (2005) 208-209.

At the International Coccidiosis Conference in Brazil, Greg Mathis reported that necrotic enteritis was also found in conjunction with coccidiosis in commercial broiler farms in the United States, confirming that this association is a worldwide problem. "Necrotic enteritis association with *Eimeria acervulina* and *E. maxima*". Proceedings page 188.

Ralph Marshall and colleagues from VLA presented results from a study investigating if a bacterial suspension of *B. subtilis* could be used as a prophylactic to control necrotic enteritis caused by *Eimeria maxima* and *Clostridium perfringens* in chickens. It was reported that intestinal lesions were reduced in treated birds. Work is ongoing. "Application of *Eimeria maxima* to a *Clostridium perfringens*-associated model for studying bacterial competitive exclusion in poultry, Marshall *et al.* Proceedings of 9<sup>th</sup> International Coccidiosis Conference, Brazil, September 2005, and WAAVP 20<sup>th</sup> International Conference, New Zealand, October 2005.

## Technical

An article in World Poultry by R B Williams described a method for assessing the gut integrity of chickens following coccidiosis. Ray developed the method in conjunction with Ralph Marshall at Weybridge, and a series of photographs in the article demonstrate the damage suffered in the intestine following a challenge with *Eimeria*. "Direct assessment of physical gut integrity by mucosal examination", World Poultry (2005) Vol.21 No.10.

## COCCIDIOSIS CATTLE

A review article by Dausgies and Najdrowski gave a very good overview of coccidiosis caused by *Eimeria* in cattle. The paper covered many aspects of the disease including prevalence, impact, biology, clinical coccidiosis, pathophysiology, epidemiology, immunity diagnosis and control. "Eimeriosis in cattle: current understanding", J Vet Med B 52 (2005)417-427.

## Prevalence

A study on *Eimeria* species in dairy cattle in Guangdong province of China detected the highest prevalence in 8-18 month old calves, (51%), then 1-8 month old calves, (40%) and adults 6%. Mixed infection with 2 or 3 species was common. (abstract L95 Proceedings of the 20<sup>th</sup> WAAVP conference, Christchurch, October 2005)

## Treatment

Pathology and treatment of *Eimeria zuernii* coccidiosis in calves: investigations in an infection model. Mundt, -H-C and others, Parasitology-International 54(2005): 223-230

Two studies were conducted in the *Eimeria zuernii* infection model in order to

investigate the pathology of *E. zuernii* coccidiosis and the efficacy of toltrazuril (Baycox 5% suspension) in this infection. For this purpose, a total of 30 calves were infected experimentally with *E. zuernii* oocysts and faecal samples taken regularly from the rectum and examined for faecal consistency and oocyst excretion. Six of the calves underwent pathological examination at various points in time after infection. Significant macroscopic and microscopic changes were demonstrated and parasitic stages were identified in the intestinal mucosa of infected calves during the late prepatent and patent period. Inflammatory reactions revealed by light microscopy were confirmed by electron microscopical investigations. Treatment of calves with toltrazuril during the late prepatent period resulted in significantly lower frequencies of diarrhoea and levels of oocyst excretion, and weight gain was significantly higher than in sham-treated animals.

Metaphylactic treatment in calves with diclazuril (Vercoxan, to be marketed for calves in the UK from Jan 2006) and toltrazuril (Baycox-not available for calves in the UK) was discussed in a number of papers and posters at the WAAVP conference in Christchurch, October 2005. Mainly because, in general, therapeutic treatment of coccidiosis is less effective as mucosal lesions in the intestine are already present. Metaphylactic treatment with toltrazuril at day of turnout, or 1 day later in yearling calves on a farm with a known *E. alabamensis* problem, or treatment at day 4 or day 7 post turnout, led to a reduction in diarrhoea and increased weight gain in the treated calves (a single oral dose of 5mg/kg was used.)  
Epe, C. et al Parasitology Research 97 (2005) S127-S133

Treatment with toltrazuril was given 14 days after movement to rearing accommodation on commercial farms, where *E. bovis* and *E. zuernii* infections were known to cause problems. Treatment in the prepatent period on these farms caused a reduction in diarrhoea and oocyst production.  
Mundt H-C. et al, Parasitology Research 97 (2005) S134-S142.

A similar study with diclazuril in calves on commercial farms showed an improvement in growth rate and reduction in *E. bovis* and *zuernii*, even when clinical signs were not apparent. Treatment was given as a single dose just before the time of an expected outbreak of coccidiosis.  
abstract E4.5, Proceedings of the 20<sup>th</sup> WAAVP conference, Christchurch, October 2005)

## COCCIDIOSIS IN SHEEP

Faecal *Eimeria* oocyst excretion, body weights, humoral antibodies against *E. ovinoidalis* sporozoite antigen and related heritabilities were determined in housed Merinoland sheep lambs throughout a period of 100 days after birth in Germany. Altogether 10-11 *Eimeria* spp. were found. Cumulative incidences of *E. ovinoidalis* and *E. weybridgensis/crandallis* increased rapidly resulting in almost 100% incidence in 8 weeks old lambs. In the other species, the cumulative incidence increased more continuously. Except for *E. granulosa*, oocysts of all species had been excreted at least once until day 30. By far the highest oocyst counts (OpG) were observed with *E. ovinoidalis*, followed by *E. weybridgensis/crandallis*. High counts were limited to the period of 5-8 weeks after birth. In the other *Eimeria* species oocyst counts persisted at comparatively low levels until the end of the observation period although their proportion of the total counts increased with age of the lambs. Time courses of

oocyst excretion suggest an early onset of effective immunity to the major *Eimeria* spp., which differed for the minor species. Mean and maximum oocyst counts and body weights of the lambs were inversely correlated suggesting negative effects of the infection on the lamb's performance. High mean antibody levels on day 7 after birth dropped until day 40 and increased subsequently again. There were no indications that maternal antibodies were protective. Antibody levels on day 40 after birth were positively correlated with oocyst counts in the faeces whereas those determined on day 80 were independent of infection parameters. Heritabilities of log<sub>10</sub> OpG were not significantly different from 0 up to an age of 60 days. Later estimated values were between 0.54 and 0.79 suggesting that immune protective effects rather than innate effects determining disease susceptibility are under genetic influence..

Reeg,-K-J; et al. *Veterinary-Parasitology*. 127(2005): 209-219

## COCCIDIOSIS IN OTHER MAMMALS

Two papers by Gaudie *et al* (VLA Thirsk) reported an outbreak of coccidiosis in pigs in which very high numbers of oocysts of 6 species of *Eimeria* were identified, with histopathology revealing typical intestinal damage and parasites. "Coccidiosis in replacement gilts", *The Pig Journal* 55 (2005) 207-210 and *Veterinary Record* 157, (2005)517-518.

An interesting paper describing a new species of *Eimeria* in Reindeer in Iceland may not at first seem to be of interest to the UK, but there is a wild-running herd of reindeer in the Cairngorms, and they are also kept in zoological parks etc – so you never know! "Description of a new *Eimeria* species and redescription of *Eimeria mayeri* (Protozoa:Eimeriidae) from wild reindeer *Ranger tarandus* in Iceland", *J Parasitol* 91(2005) 353-357.