ABSTRACTS

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EPIDEMIOLOGIC STUDY OF BOVINE CYSTICERCOSIS ON TWO KANSAS FEEDLOTS.

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From October 1977 through May 1978, 586 carcasses (3.5%) of 16,591 cattle processed from a feedlot in southwestern Kansas were found infected with cysticerci (Taenia saginata). An investigation of possible sources of transmission strongly suggested that an employee or employees at the lot had contaminated feed additives. The period of contamination was judged to be from August through November 1977, a time coincident with that spent by temporary workers on this lot. Cattle processed after May 1978 were apparently negative. In October 1978, 27 of 55 cattle from one pen were reported positive for cysticerci but these cattle were all from one site in Texas.

The next outbreak was reported on a feedlot 50 miles west of the first lot. This involved 12,775 cattle with 4491 carcasses found infected (35.5%) and 38 condemned. The time period for detection of cysticercus-positive carcasses was June through October 1978. Investigation of this incident revealed that four transient workers of Mexican origin had worked on the lot from April 15 to about June 15, 1978. All had been examined by a local physician and one had been diagnosed as positive for T. saginata. Coincidentally, this man had also worked at the first lot the preceding fall. Mixing bins were again believed to be the site where contamination of feed occurred.

Recommendations were made to help in the prevention of future outbreaks.

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ECONOMICS OF TRICHOMONAS FOETUS INFECTIONS IN OKLAHOMA BEEF CATTLE.

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Trichomoniasis, caused by Trichomonas foetus, is a widespread disease of cattle throughout the world. In Oklahoma, with the nation's third largest beef cow population, bovine trichomoniasis has not been well documented although identification of infected animals has been made at the O.S.U. College of Veterinary Medicine for many years. The present study was designed to determine the prevalence of Trichomonas foetus in beef bulls at a large Oklahoma public auction and to estimate the potential impact of this organism on the Oklahoma beef industry.

A total of 280 bulls were examined with a total of 22 (7.8%) yielding identifiable Trichomonas foetus organisms. Prevalence appears to increase with age among the animals examined and Hereford, Angus, and Brahmas showed the greatest species susceptibility. Based on the findings of this study and the 1978 estimated Oklahoma cattle population, a discussion will be presented estimating the direct and indirect losses resulting from Trichomonas foetus infections in Oklahoma.

THE PREVALENCE OF INTERNAL PARASITES IN CATTLE FROM IRRIGATED AREAS IN CENTRAL IDAHO.

T. A. SHELTON and R. B. WESCOTT, College of Veterinary Medicine, Washington State University, Pullman, Washington.

Five ranches in the Butte County production testing program were selected for the study. All practiced individual animal identification and the group included most types of herd grazing conditions typical for the area. During the first week of June, 1978, fecal samples were collected rectally from 25-50 adult cattle at each location. This procedure was repeated in five weeks and one additional sampling from weaned calves at three ranches was obtained during the fall of 1978. Samples were analyzed using sugar flotation and sedimentation techniques. The parasite stages present were recorded as "strongylin" (Ostertagia, Trichostrongylus Cooperia, etc.), Trichuris, Nematodirus, Moniezia, or Fasciola eggs or coccidial oocysts. No attempt was made to distinguish among the genera represented in the strongylin catagory but the morphology of the eggs suggested several important nematodes of cattle were present.

The fecal examinations from older cattle revealed mean strongylin egg counts (EPG) of 403,137,93,58, and 36 for the five ranches which suggests moderate to severe parasitism can occur in older cattle in this geographic area. The egg counts of the fall calves were less than those of adult cattle and did not always reflect the same levels of parasitism. Most samples also contained small numbers of coccidial oocysts, but few other parasites were observed. The relative levels of strongylin parasites found in each herd were related to the type of pasture and pasture management practiced and problem of control was discussed.

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EVALUATION OF FENBENDAZOLE AGAINST INHIBITED LARVAE OF OSTERTAGIA OSTERTAGI.

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Panacur (fenbendazole Ⓣ, Hoechst AG, Frankfurt, West Germany) was the first of several new benzimidazole anthelmintics proven to have a high level of efficacy against inhibited early fourth stage larvae of Ostertagia ostertagi. Although some variability in efficacy against inhibited Ostertagia has been demonstrated, the compound has been highly effective in removal of inhibited larvae as well as nearly all gastrointestinal nematodes of cattle in many studies. During the winter and spring of 1977-78, epidemiologic investigation of O. ostertagi in yearling cattle was undertaken in northwest Louisiana. When it was determined that numbers of inhibited larvae were at peak levels (April, 1978), the evaluation of fenbendazole was undertaken. Thirty animals were removed from pasture and maintained free from further helminth infection until slaughter (19-21 days). Fenbendazole (10% liquid suspension) was administered as an oral drench at 10 mg/kg to 10 animals and at 15 mg/kg to an additional 10 animals at 10 days after removal from pasture. Eleven animals served as untreated controls. At 10 mg/kg,

the following reductions were observed: O. ostertagi adults - 100%, developing stages - 80%, inhibited larvae - 97%, other worm genera in the abomasum and nematodes of the intestinal tract - 100%. At 15 mg/kg, the following reductions were observed: O. ostertagi adults - 100%, developing stages - 98%, inhibited larvae - 99%, other worm genera in the abomasum and nematodes of the intestinal tract - 100%. The finding of dead and decomposing early fourth stage larvae in mucosal washings immediately post mortem and in histopathologic sections of the abomasum, indicated that a longer interval between treatment and slaughter might yield higher efficacy values.

Supported in part by a grant from Hoechst-Roussel Pharmaceuticals, Inc., Somerville, New Jersey 08876.

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SEASONAL INCIDENCE OF INFECTIVE AND HYPOBIOTIC NEMATODE LARVAE ON IRRIGATED PASTURE GRAZED BY CATTLE IN CALIFORNIA.

N. F. BAKER, R. A. FISK, R. B. BUSHNELL, AND M. N. OLIVER, School of Veterinary Medicine, University of California at Davis, Davis, California.

Worm-free tracer calves were utilized over a twelve-month period in 1976 to determine seasonal infection levels of "normal" and "hypobiotic" infective larvae of cattle nematodes. Infection levels of Ostertagia and Cooperia were highest in spring and fall. Only in March and April did large numbers of Ostertagia exhibit hypobiosis while hypobiosis in Cooperia occurred to an equal extent in spring and fall. The results of the study indicated there is normally only a small number of infective nematode larvae on ingested forage from irrigated pastures in the Sacramento Valley during summer months.

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DEMONSTRATION OF ANAPLASMA MARGINALE THEILER IN TICKS BY TICK TRANSMISSION, ANIMAL INOCULATION, AND FLUORESCENT ANTIBODY STUDIES.

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Cattle were inoculated with a Virginia isolate of Anaplasma marginale Theiler and served as an infective source for laboratory-reared Dermacentor andersoni Stiles and D. variabilis (Say) nymphs. Transstadial transmission of A. marginale was demonstrated by feeding the newly molted adult ticks on susceptible cattle and by inoculation of gut and salivary gland homogenates collected from infected adult ticks at day five and seven of feeding. Oral secretions collected from the same group of ticks and inoculated into a susceptible cow did not cause infection. Fluorescent antibody (FA) studies of infected tick gut and salivary glands were positive for fluorescence. The presence of A. marginale in the gut and salivary glands of both tick species was confirmed by animal inoculation and F.A. studies.

EFFECTS OF RABON ON NEMATODE EGG COUNTS AND PERFORMANCE OF CATTLE.

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Rabon (tetrachlorvinphos) was evaluated for anthelmintic efficacy against gastrointestinal parasites and for its effect on performance of beef cattle on pasture. Rabon 97.3% Oral Larvicide was incorporated into a mineral mixture of equal parts of dicalcium phosphate and trace minerals. The cattle were divided into three groups. One group was offered nonmedicated mineral ad lib and served as a control group. A second group ate mineral mixture with Rabon to deliver a dose rate of 1.6 mg/day/kg of body weight (1X group). A third group received medicated mineral to deliver 2.7 mg/day/kg (1 3/4X). In the 1977 experiment egg counts showed that the level of parasitism was two and three times lower in the 1X and 1 3/4X groups, respectively, than in the control calves. A lower percentage of calves from the medicated groups was infected with tapeworms, than from the controls. The 1X calves had an average weight advantage of 1 kg and the 1 3/4X calves of 11.8 kg over the control calves. In 1978, however, the medicated calves had twice as many nematode eggs than control calves, but more control calves were infected with tapeworms. Again, the 1X and 1 3/4X Rabon groups had 9.7 and 12.8 kg average weight advantage, respectively, over the control calves. Data from a separate experiment with 121 cows and their calves indicated average body weight advantages of 17 and 18.3 kg for the 1X and 1 3/4X calves over the control calves.

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TOXOPLASMIC ABORTIONS IN GOATS.

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Six seronegative (dye test < 1:16) goats in mid-pregnancy were each fed 10^4 infectious Toxoplasma gondii oocysts. Three goats in mid-pregnancy served as uninoculated controls. The inoculated goats became dull, anorectic, pyrectic (up to 107° F), and developed cough and diarrhea within two to ten days post inoculation (DPI); control goats remained asymptomatic. Two goats and their fetuses died of toxoplasmosis 10 DPI, two goats aborted at 24 and 41 DPI, and two had normal but infected kids 24 and 26 DPI. Toxoplasma gondii was isolated from the tissues of four fetuses or kids and from the placenta of three. Each of three control goats had two uninfected normal kids 10, 35, and 36 days after the beginning of the experiment.

RESISTANCE TO FREEZING OF THE ARCTIC STRAIN OF TRICHINELLA SPIRALIS.

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In 1978, 22 of 25 persons who ate meat from an Alaskan black bear became ill with trichinosis despite the fact that the meat had allegedly been frozen at -18° C (0° F) for periods of time that are generally accepted as sufficient for killing Trichinella spiralis larvae. Digestion examination of this meat revealed larval counts as high as 1000 larvae/gm. USDA regulations state that for cuts of pork < six inches thick the following time/temperature treatments are adequate to render T. spiralis noninfective: -15° C (5° F) for 20 days; -23° C (-10° F) for 10 days; -29° C (-20° F) for 6 days. Some of the suspect bear meat was shipped to us in Atlanta, and we froze samples at temperatures ranging from -14° C to -20° C (mean -15° C) for periods from 14 to 35 days. There were no differences in larval counts between samples of meat frozen at those temperatures compared with refrigerated meat (10° C) held for the same lengths of time. Larvae in frozen meat were equally as infective to cotton rats as were larvae in refrigerated meat.

T. spiralis recovered from the bear meat were established in cotton rats and their resistance to freezing was compared to T. spiralis recovered from a pig and established in white rats (first generation). The swine isolate T. spiralis was apparently completely killed after 10 days at -15° C, -20° C or -70° C. However, viable larvae of the arctic strain were recovered from cotton rat carcasses frozen for 7 to 10 days at -15° C, -20° C, and -70° C, although the numbers of larvae per gram of tissue were markedly reduced compared with the other half of each carcass which was maintained at refrigeration temperature. Viable arctic strain larvae were also recovered from carcasses held for 20 days at -15° C and -20° C but not at -70° C. The internal temperatures of the carcasses were recorded by thermocouples introduced into the meat. The taxonomic and public health significance of these findings will be discussed.

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THE RELATIVE EFFICACIES OF PYRANTEL TARTRATE AND PYRANTEL CITRATE AGAINST OESOPHAGOSTOMUM SP. IN PIGS.

S. E. PRATT, M. A. BRAUER, and R. M. CORWIN, Department of Veterinary Microbiology, University of Missouri, Columbia, Missouri.

The efficacy of pyrantel citrate against Oesophagostomum sp. in swine was evaluated in a critical control study and a field trial.

In the critical control study, the efficacy was compared to that of pyrantel tartrate. Eighteen pigs of mixed breed were naturally infected with Oesophagostomum sp. and were randomly assigned to three groups. The two test groups received either pyrantel citrate or pyrantel tartrate (464 g pyrantel base/ton) in one pound of feed per 40 pounds of pig on day one of the trial and grower ration (15% corn-

soy) thereafter. The control group was given the grower ration only. On day six post-treatment all pigs were necropsied, worms were recovered and counted and fecal samples were examined. The efficacies of pyrantel citrate and pyrantel tartrate were 100% based upon comparative counts of Oesophagostomum worms and eggs from pigs in the three groups.

The field trial was conducted in a similar manner, except that 38 pigs were used, pyrantel citrate only was tested against a control group, and worm counts were not made. On the basis of fecal egg counts (Wisconsin Technique) made at the beginning and at the termination of the trial, pyrantel citrate was found to effectively reduce Oesophagostomum egg counts by 83.6%.

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CHEMOPROPHYLACTIC AGENTS FOR THE PREVENTION OF THE THREE MAJOR PARASITES OF PIGS.

J. P. RAYNAUD, M. VIRAT, and D. P. CONWAY, Pfizer International, Inc., 235 E. 42nd Street, New York, New York.

Authors withdrew paper from the program.

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ACUTE ORAL LD_{50} OF HALOXON IN SHEEP AS INFLUENCED BY PLASMA ESTERASE.

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The LD_{50} of Haloxon for sheep, unclassified as to the presence or absence of plasma esterases hydrolysing haloxon, has been reported to be 1378 mg/kg body weight with 95% confidence limits of 1024 to 1848 mg/kg [Res. Vet. Sci. 5 (1964): 17-31]. California studies in sheep classified as to the presence (ESA+) or absence (EsA-) of an esterase hydrolysing haloxon revealed markedly different LD_{50} values for the two phenotypes of sheep. The LD_{50} for ESA- sheep was found to be 764.5 mg/kg body weight with 95% confidence limits of 545 to 1074 mg/kg body weight. The LD_{50} for EsA+ sheep was not determined but was demonstrated to be in excess of 11,392 mg/kg body weight. The LD_{50} for a closely related organophosphate (coumaphos) was not significantly different in the two phenotypes of sheep.

OBSERVATIONS ON THE EARLY DEVELOPMENT OF SOME TRICHOSTRONGYLID NEMATODES IN THE GERBIL MERIONES UNGUICULATUS.

E. PANITZ and K. L. SHUM, Schering Corporation, Animal Health Research Center, Allentown, New Jersey 08501.

Experimental infections and subsequent development of Ostertagia circumcincta, Haemonchus contortus and Trichostrongylus colubriformis in the mongolian gerbil were studied.

Ostertagia circumcincta exsheathed two to six hours after infection; development proceeded no further.

Haemonchus contortus exsheathed by six hours, penetrated stomach villi by 24 hours and had reached early 4th stage by 72 hours and continued growing through 14 days after infection. H. contortus were expelled from the stomach in logarithmic fashion. Length and width measurements followed the regressions: (a) Length (in microns) = 3.375 x (time in hours)+ 569.3, (b) Width (in microns) = 0.058 x (time in hours) + 14.8.

Trichostrongylus colubriformis completed its life cycle in the small intestine. Exsheathment occurred in the stomach by six hours after infection. By 72 hours the 4th stage had developed in the small intestine. Worms reached maturity by 14 days evidenced by presence of eggs in females.

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INTERACTION OF NEMATODE PARASITES IN MICE.

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The rejection of Nippostrongylus brasiliensis infections by mice has been studied in our laboratory for several years with a number of techniques including fluorescent antibody (FA) and scanning electron microscopy (SEM). In recent experiments development and survival of N. brasiliensis was compared for a period of up to 90 days in mice infected concurrently with varying numbers of Nematospiroides dubius and in nonparasitized controls. Rejection of N. brasiliensis occurred in hosts harboring N. dubius but not as rapidly or completely as in controls and these differences were more pronounced in hosts with heavy (125±) than with light (25±) N. dubius infections. Some N. brasiliensis which were not rejected initially survived for 90 days in mice infected with N. dubius but no N. brasiliensis were observed in controls after 18 days. The nature of the alteration of rejection of N. brasiliensis appeared similar to that observed elsewhere for Trichinella spiralis and N. dubius, and Trichuris muris and N. dubius. The cause of the prolonged survival of N. brasiliensis was not determined. Possible mechanisms involved in these interactions were illustrated and discussed.

ANTHELMINTIC EVALUATION: GRANULATED FENBENDAZOLE IN CATS WITH INDUCED AND NATURALLY OCCURRING INFECTIONS.

E. L. ROBERSON and T. M. BURKE, College of Veterinary Medicine, University of Georgia, Athens, Georgia.

A granulated formulation of 22% fenbendazole (Panacur®, Hoechst AG, Frankfurt, Federal Republic of Germany) was tested for anthelmintic activity against feline helminths. The drug was administered in 20 grams of canned food on each of three days at a dosage of 50 mg/kg b.w./day. Of 31 young adult cats harboring naturally occurring infections of Toxocara cati, 16 were treated and 15 served as controls. There was 100% clearance of ascarids from all treated cats (total of 234 ascarids expelled). Among controls, 82% of the ascarid burden was retained (124 of 152 worms). Six test cats and six controls also had naturally occurring hookworm infections (Ancylostoma tubaeforme). All treated cats were cleared of this parasite (1-131 worms). Controls were not cleared (1-8 worms).

Thirty other cats were acclimated for two months prior to experimentally infecting them with Aelurostrongylus abstrusus, Taenia taeniaeformis, and Ancylostoma tubaeforme (62, 60, and 40 days, respectively, before treatment). Necropsy was delayed until the 28th day following treatment to assess the effect of the drug on the natural expulsion of lungworm larvae per gram of feces.

Treatment caused a transitory reduction in the numbers of lungworm larvae. The numbers of live adult lungworms and numbers of lesions in treated cats were approximately half the numbers found in controls (no significant differences).

Fenbendazole was highly effective against A. tubaeforme and T. taeniaeformis. The cats harbored an average of 127 hookworms each; 99.9% of these were expelled from 16 treated cats as compared with a 2% natural expulsion from 15 control cats. Of 22 cats which developed patent infections of Taenia taeniaeformis, eleven were treated and cleared of this parasite while nine of eleven controls continued to harbor 1 to 10 tapeworms at the time of necropsy.

Fenbendazole at a dosage of 50 mg/kg/day x three days appears to be a highly effective anthelmintic against the common ascarid, hookworm, and tapeworm of cats. Its activity against lungworms was inconclusive at the dosage used but the data suggest the need for investigating its activity against this parasite at higher dosages, longer periods of treatment, or both.

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APPLICATION OF NEW TECHNIQUES FOR THE STUDY OF OSTERTAGIASIS.

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A new technique, originally developed to isolate intact, respirating gastric glands from rabbit stomachs, was adapted for the purpose of obtaining histologic preparations of abomasal mucosa which allowed improved visualization of glandular architecture and foreign bodies located in glandular tissue. By this technique the

abomasal mucosa is freed from the underlying connective tissue and serosa. Anesthetized calves were exsanguinated while the abomasum and the left gastro-epiploic artery were exposed. This artery was cannulated and perfusion of the abomasum was begun (after the abomasum was incised along the greater curvature and the contents washed away) with a bolus of heparin followed by physiological saline buffered to pH 7.3. Perfusion was conducted at a pressure of 600 mm Hg. The mucosa was readily separated from the serosa by blunt dissection and then cut into 1 cm squares for fixation in buffered formalin. This procedure, from the start of exsanguination to tissue fixation, required about five minutes. The abomasa of three-month-old calves, reared parasite free, were examined by this procedure following experimental infection with Ostertagia ostertagi. Intact and perfused sections of abomasa were compared in early (3-6 day post infection) stage infections and non-infected animals. Perfusion of abomasal mucosa allowed better characterization of glandular structures and the cellular components of inflammatory reactions at the glandular level. Foreign bodies, seen only in mucosae after perfusion, appeared to contain cuticular protein (stained by Movat's technique) and they also demonstrated slight birefringence under polarized light.

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CONTROL OF SHEEP HELMINTHS IN OHIO: ARRESTED LARVAE AND THE PERIPARTURIENT RISE (PPR).

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Studies in Ohio in 1977 and 1978 showed that most infective L3 ingested from pastures in October and November were arrested in their development when sheep were slaughtered in December each year. Thus 98-99% of Haemonchus, 89-96% of Ostertagia, 77-82% of Nematodirus and 0-9% of Trichostrongylus were arrested.

In a controlled drug trial with 60 naturally infected lambs in 1978, levamisole (8 mg/kg) was highly effective against both adult and arrested stages of all the above species ($p < .005$). In contrast, thiabendazole (44 mg/kg) and fenbendazole (5 mg/kg) failed to cause significant reductions in Ostertagia or Haemonchus adults or larvae. Even a threefold dose of fenbendazole (15 mg/kg) failed to have a significant effects on Ostertagia, the predominant parasite in the sheep. Furthermore, levamisole was significantly ($p < .01$) more effective than thiabendazole against Trichostrongylus colubriformis.

Studies with 130 lambing ewes in 1978 showed a marked PPR in worm egg counts. A pre-lambing treatment of ewes with levamisole (8 mg/kg) or fenbendazole (15 mg/kg) completely eliminated the PPR, but fenbendazole (5 mg/kg) was only partly effective. Post lambing treatments with all drugs were ineffective because the PPR had already reached its peak at the time of the treatment.

The results of this study indicate that three important worms (Ostertagia, Haemonchus and Trichostrongylus) have developed resistance to thiabendazole and exhibit cross resistance to fenbendazole. The results indicate that levamisole (8 mg/kg) is the anthelmintic of choice for sheep, as it has high efficacy against

benzimidazole-resistant worms, arrested worms and the PPR. A small number of strategic treatments (winter, pre-lambing, weaning) integrated with judicious grazing management should be of benefit, low cost and unlikely to select for drug resistance.

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Monday, July 23, 1979

PATHOGENESIS AND TREATMENT OF FASCIOLOIDES MAGNA INFECTIONS IN GOATS.

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Experimental Fascioloides magna infection was fatal to goats within seven months post-infection. Development of the fluke was similar to that in sheep, i.e. unrestricted migration of flukes in hepatic parenchyma resulting in death of the host before maturation of the fluke. Flukes were recovered from liver, lung, pancreas and peritoneal cavity. Recovery rate of F. magna from administered metacercariae was approximately ten percent. Growth of the fluke in goats was essentially the same as fluke growth in white-tailed deer, sheep and cattle.

Treatment with albendazole at approximately 15 mg/kg of body weight by oral administration as paste was efficacious against F. magna and prevented death of the host.

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DIAGNOSIS OF FASCIOLA HEPATICA IN CATTLE BY ENZYME-LINKED IMMUNOSORBENT ASSAY (ELISA).

C. J. FARRELL and D. SHEN, College of Veterinary Medicine, Washington State University, Pullman, Washington.

An enzyme-linked immunosorbent assay (ELISA) was evaluated for diagnosis of Fasciola hepatica infection in cattle. Sera from experimentally and naturally infected calves were tested with three antigen preparations and compared to sera from normal controls. Fresh fluke saline extract detected specific antibody as early as four to five weeks postinfection. Frozen fluke saline extract was less sensitive than fresh fluke antigen and did not demonstrate presence of antibody until eight to ten weeks after infection. Purified fluke extract produced lower titers than either the fresh or frozen antigen and was less specific for diagnostic purposes.

The test was easy to perform and required few reagents. Little laboratory time was invested in the actual manipulations of the test and expensive instrumentation was not required for qualitative measurements. Quantitative measurement required the use of a spectrophotometer. The test has the potential of replacing the time-consuming fecal sedimentations presently used for F. hepatica diagnosis with the added benefit of detecting the infection before the parasites are mature and eggs are present in feces.

INFLUENCE OF ANIMAL HUSBANDRY ON THE OCCURRENCE OF TROPICAL FASCIOLIASIS (F. GIGANTICA).

T. W. SCHILLHORN VAN VEEN, Department of Microbiology and Public Health, College of Veterinary Medicine, Michigan State University, East Lansing, Michigan.

Fascioliasis (F. gigantica) in West Africa is mainly observed in the savanna area. The climatic conditions towards the Sahel are unfavorable for survival of the aquatic snail intermediate-host Lymnaea natalensis, and the conditions in the southern regions, with a high prevalence of fly borne diseases, preclude the presence of large numbers of livestock. Studies in the Nigerian savanna during 1972-1977 indicated, however, that the incidence of Fasciola infections in the savanna varied considerably depending on the seasonal variations in the snail populations, as well as on the seasonal movements of livestock. The main periods during which young (susceptible) snails are present are the rainy season and the beginning of the dry season. Traditionally during that period, most of the migratory livestock have moved out of the areas with high snail-densities to the tsetse-free area, which coincidentally is also less suitable for development and survival of Lymnaea. The absence of livestock combined with the limited drought-resistance of Fasciola eggs prevents a significant build-up of Fasciola infections in the snail population during the wet season.

When the livestock, during the dry season, return to the fly and snail area, the Lymnaea populations are declining and the acquired larval Fasciola infections were of little epidemiological importance. For these reasons, outbreaks of clinical fascioliasis have, to date, mainly occurred in sedentary livestock. This epidemiological model, with limited grazing in snail-infested areas during the wet season, was applied on a small scale in a farm with fluke problems, and it proved to be useful in preventing outbreaks of acute fascioliasis in sheep.

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OCULAR TOXICITY IN SHEEP OF A NOVEL FASCIOLICIDE.

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The halogenated benzenesulfonanilide, 2-hydroxy-2',3,4',5,5',6-hexachlorobenzenesulfonanilide, has recently been reported to possess potent fasciolicidal activity (Hayes and Mitrovic, Experientia 35:325-326, 1979). It was also reported (loc. cit.) that at >5 times the therapeutic dose, blindness occurred in sheep. The ophthalmoscopic features of toxicity in sheep with this novel fasciolicide will be presented using color transparencies of external and internal ocular changes observed following high doses. They include corneal edema, equatorial lens opacities, papilledema, and retinal vessel changes. The presentation will demonstrate the development of dose-related ocular toxicity at high doses and provide the veterinary clinician and researcher with clinical features of potential ophthalmic changes with halogenated fasciolicides at overdosage.

EFFICACY OF ALBENDAZOLE AGAINST NEMATODIRUS HELVETIANUS, DICTYOCAULUS VIVIPARUS AND FASCIOLA HEPATICA INFECTIONS IN RUMINANTS.

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A drench formulation of albendazole (Valbazen) given as a single dose at the rate of 5 mg/kg body weight reduced naturally acquired Nematodirus helvetianus populations in cattle approximately 98%. Efficacy against experimentally induced lungworm (Dictyocaulus viviparus) infections was essentially 100% vs. adult parasites. Field studies in sheep naturally infected with Fasciola hepatica indicated that a single 7.5 mg/kg dose reduced fecal egg counts approximately 84%, whereas two 7.5 mg/kg doses at five-week intervals reduced fluke egg counts approximately 99%. No evidence of drug-related side effects was noted at the levels tested, despite the fact that both groups of sheep exhibited varying degrees of chronic fascioliasis which had resulted in sporadic mid-winter mortality in breeding ewes. The clinical response of both affected flocks to treatment suggested that drug activity was directed against patent adult infections acquired during the previous grazing season.

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A STRONGYLOIDES STERCORALIS-LIKE PARASITE IN A DOG SHEDDING EGGS, EMBRYONATED EGGS AND LARVAE IN THE FECES.

J. B. MALONE, E. B. BREITSCHWERDT, M. D. LITTLE, R. OCHOA, and K. A. WOLF, College of Veterinary Medicine, Louisiana State University, Baton Rouge, and Tulane University, New Orleans, Louisiana.

Strongyloides stercoralis-like parasites were recovered from the jejunum and ileum of a six-month-old Boston Terrier that was shedding unusually large eggs, both unembryonated and embryonated, as well as firststage larvae in fresh feces. The infection was associated with stunting, mucoid and blood flecked stools, diffuse interstitial pulmonary changes, focal dermatitis, and mild anemia. Decreased intestinal absorption of carbohydrate was found by the oral glucose and oral lactose tolerance tests. Hypoproteinemia and hypocalcemia were present. Histopathological changes included uneven crypt hyperplasia and mild inflammation associated with parasites in the ileum and jejunum, diffuse interstitial pulmonary inflammation, Kupffer's cell hyperplasia in the liver, and lymphoid hyperplasia of lymph nodes. The taxonomic status and diagnosis of the unusual parasites recovered are discussed.

TREATMENT OF DOGS WITH DIPETALONEMA MICROFILAREMIAS.

R. G. SCHOLTENS, A. M. LEGENDRE, and J. P. WEIGEL, Department of Pathobiology, University of Tennessee, Knoxville, Tennessee.

Five dogs with patent infections of Dipetalonema reconditum were treated with levamisole at 5 mg/kg. Microfilariae in three dogs treated for ten days disappeared within three days and did not reappear during a 49 day observation period. Two dogs treated for five days had no evidence of infection 70 and 82 days post-treatment. It seems levamisole at these dosages may be lethal for both juvenile and adult Dipetalonema reconditum.

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EVALUATION OF A NEW TREATMENT FOR CANINE DEMODICOSIS.

S. D. FOLZ, T. J. KAKUK, D. D. KRATZER, R. D. CONKLIN, L. H. NOWAKOWSKI, and D. L. RECTOR, The Upjohn Company, Kalamazoo, Michigan.

Mitaban ^{R} Liquid Concentrate, a new miticide, was initially reported as being efficacious for treatment of experimentally induced canine scabies and demodicosis. The 250 ppm concentration of active drug (amitraz: N'-(2,4-dimethylphenyl)N-{[2,4-dimethylphenyl)immino]methyl]}-N-methyl-methanimidamide) was selected as optimal for treatment of both parasitic dermatoses.

Forty-two dogs naturally parasitized with Demodex canis and having generalized demodicosis were utilized to further evaluate the efficacy and clinical safety of Mitaban. In a separate experiment, 30 Beagles were used to assess the safety of Mitaban at 0 (control), 1, 3, and 5 times the recommended concentration.

The data indicated that Mitaban (250 ppm) was efficacious and safe as a dermatotherapy for naturally acquired demodicosis. Three to six treatments were administered at 14 day intervals. An average of 4.5 treatments were administered to clear dogs of viable mites and to achieve a high rate of clinical improvement (98%). Ninety-six percent (96%) of the treated dogs were cleared of mites, and all dogs treated with Mitaban responded clinically. A controlled safety study utilizing Beagles indicated that Mitaban Liquid Concentrate has at least a 5 x margin of safety.

ASPECTS OF FILAROIDES HIRTHI LUNGWORM INFECTION IN DOGS.

J. R. GEORGI, Department of Pathology, New York State College of Veterinary Medicine, Cornell University, Ithaca, New York.

First stage larvae of Filaroides hirthi, whether still enclosed in the egg shell or already hatched, developed into adult lungworms 32 to 35 days after oral, intravenous, or intralymphatic administration. Within six hours after oral administration, first stage larvae began to arrive in the lungs where development proceeded through all five stages, molts occurring at approximately 1, 2, 6, and 9 days after infection. Larvae progressed from the alimentary tract to the lungs by way of the hepatic portal circulation, the mesenteric lymphatic drainage, or both. Development to the fourth stage was occasionally observed in the mesenteric lymph nodes. Larvae developed in vitro as far as the doubly ensheathed third stage, which is the stage achieved by heteroxenous metastrongyloids in their mulluscan intermediate hosts. The morphological characteristics of F. hirthi L1, L2, L3, and L4 are typical of the superfamily Metastrongyloidea.

Transmission of F. hirthi infection among cagemate puppies was demonstrated to occur through the ingestion of first stage larvae in recently passed feces and evidence was adduced to the effect that nursing pups acquire their F. hirthi infections by ingesting first stage larvae in their dam's feces starting when they are four or five weeks old and beginning to ingest solids.

Medication with albendazole at a dosage rate of 25 to 50 mg/kg twice daily for five days killed all but a small proportion and sterilized the few surviving F. hirthi worms in artificially infected Beagle pups. Medication of 15 naturally infected, larva-shedding brood bitches with two courses of albendazole completely prevented F. hirthi infection in a sample of 21 of their progeny whereas 16 of 19 pups (84%) from 14 non-medicated infected dams were found, on necropsy examination, to harbor mature F. hirthi lungworms.

Because of its infectivity in the first larval stage, F. hirthi is capable of autoinfection, which in the presence of depressed cell-mediated immunity may result in fatal hyperinfection, as illustrated by a spontaneous case in a stressed pup. However, the great majority of F. hirthi infections are entirely asymptomatic.

Careful morphological study of the caudal end of male worms is essential to distinguish F. hirthi, F. milksi, and Anderstrongylus captivensis, a similar parasite of skunks. Total body measurements are completely unreliable as differential characters and cross-sectional anatomy does not afford sufficient clues to distinguish these lungworms in histological sections. Therefore, reports purportedly concerning these three species but lacking sufficient objective morphological evidence to establish their exact identity beyond question should be ignored.

Transient patent infection of a Beagle pup with Anderstrongylus captivensis was achieved by feeding lung tissue of an infected striped skunk.

MAST CELLS/BASOPHILS AND POTENTIAL PARASITE INTERACTIONS.

R. WESLEY LEID, Department of Pathology, Michigan State University, East Lansing, Michigan.

It is becoming increasingly clear that the tissue mast cell and its circulating counterpart, the basophil, occupy a crucial position in the matrix of interconnecting cellular and chemical components which make up the inflammatory system. Their responsiveness to both nonspecific and immunologic stimuli and, conversely, their sensitivity to modulating influences of other effector cells have only recently come under active experimental investigation. I would not propose that the effects of mast cell/basophil activation on a parasitic infection nor the effects of the organisms on mast cell modulation would necessarily be the same at each stage of infection. There are clearly times when vascular changes which accompany inflammation, such as increased permeability and local hyperemia, might facilitate movement of the parasite into blood vessels. Equally well, there are occasions, such as those where tissue larval phases become sequestered for prolonged periods, when a dampening effect on the inflammatory response might be advantageous.

In the past, much of the work on the mast cell in helminthic infections has focused on the host IgE-immunoglobulin response to parasites and the roles that these reaginic mast cell/basophil-sensitizing antibodies might have in host resistance. Preoccupation with the IgE-dependent pathway to activation has overshadowed the other unique characteristics of basophils and tissue-derived mast cells. These cells may be activated in a variety of ways, all of which could have some bearing on the survival of the parasite and the reaction of the host to helminths. Target cells, for example, may be triggered to release histamine, SRS-A or other inflammatory mediators by IgG immune complex reactions; direct mast cell degranulators; the phospholipase enzyme present in eosinophils; the cationic proteins of the neutrophil, which could be released during lysosomal secretion or by bradykinin. Few of these alternative activation pathways have been cited in the interpretation of the variety of host responses and pathologic events observed in helminthiasis.

IMMUNOLOGIC ANALYSIS OF SURFACE ANTIGENS FROM AFRICAN TRYPANOSOMES.

T. C. McGUIRE, and A.F. BARBET, Department of Veterinary Microbiology and Pathology, Washington State University, Pullman, Washington, and ILRAD, Nairobi, Kenya.

The problems of developing a useful vaccine against African trypanosomes center on the ability of the organisms to undergo antigenic variation. Antigenically distinct types have been observed at intervals during the course of an infection. The ability of trypanosomes to express variant antigens is associated with the presence of a surface structure "the coat," a layer 12-15 nm thick overlaying the cytoplasmic membrane. A number of variant surface glycoproteins (VSGs) were purified from clones of Trypanosoma brucei and tested for immunologic crossreactivity. Anti-VSG sera were clone-specific when tested by indirect immunofluorescence of living trypanosomes, but they were not clone-specific when tested by radioimmunoassay with purified ^{125}I-labeled VSGs. In this double-antibody radioimmunoassay, every VSG tested was precipitated by the homologous and all heterologous anti-VSG sera. Any unlabeled VSG could inhibit the heterologous precipitation reactions by 100%. The homologous precipitation reactions were effectively inhibited only by unlabeled homologous VSG. Crossreactions between different VSG molecules were also revealed by microcomplement fixation tests. The results confirm the presence, in VSGs, of variable determinants specific to individual VSGs and also show crossreacting determinants in all VSGs tested.

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CHICKEN COCCIDIOSIS: CORRELATION BETWEEN RESISTANCE AND DELAYED HYPERSENSITIVITY.

J. J. GIAMBRONE and P. H. KLESIUS, Poultry Science Department, Auburn University, and Southern Region Regional Parasite Research Laboratory, Auburn, Alabama.

Broiler chickens were immunized with oocysts of either Eimeria necatrix, E. tenella or with a commercially prepared vaccine (CocciVac^{R}D) containing viable oocysts from seven chicken Eimeria species. Before challenge with oocysts of either E. necatrix or E. tenella delayed hypersensitive skin (wattle) reactions to particulate oocysts antigen extracts of either E. maxima, E. necatrix and E. tenella were demonstrated in the previously immunized broilers. Broilers immunized, wattle tested and challenged with E. necatrix or E. tenella oocysts and antigens showed good correlation between delayed wattle reactivity (DWR) and resistance in each homologous trial. CocciVac^{R}D immunized birds also gave good correlation between DWR to either E. maxima, E. necatrix, or E. tenella antigens and resistance when challenged with either E. necatrix or E. tenella. Oocyst antigens from E. maxima, E. necatrix and E. tenella gave cross reactivity by DWR indicating some antigen sharing between chicken species. A few broilers showed DWR to oocysts antigens from E. bovis, a cattle pathogen. The results of our studies show that DWR to oocyst antigens can predict disease resistance to coccidiosis.

PATHOGENESIS AND POSSIBLE PREMUNITION ASSOCIATED WITH THYSANOSOMA ACTINIOIDES DIESING, 1834, INFECTIONS.

R. C. BERGSTROM, Division of Microbiology and Veterinary Medicine, University of Wyoming, Laramie, Wyoming.

Allen (1973) citing Rees (1967) and his own research results, described mild pathogenicity but marked bile duct fibrosis associated with T. actinioides infections in sheep. Allen also showed that body weight gains in range lambs were not significantly decreased by the tapeworm burden. Recent research at the University of Wyoming with young to aged ewes near the time of parturition would tend to support Allen's data except in the case of ewes that have dual or multiple infections with helminths and/or concomitant infections with bacteria or viruses. Since immature tapeworms are present at day 21 after albendazole treatment and the immature worms are also present at day 147 post-treatment, an immune mechanism may be present in order to arrest the development of the larval forms of T. actinioides. The mechanism of immunity in these cases resembles premunition because: 1. Few or no adult worms are present in treated sheep, even five months after treatment. 2. Immature tapeworms are found soon after treatment (21 days) and are present for a relatively long period thereafter. 3. The time of development of T. actinioides, although not precisely known, is less than five months, the period of time during which we studied treated as well as untreated natural infections. Although none of these observations proves that the phenomenon of premunition is in operation, it appears that the reinfecting worms are in an immature state for a relatively long period of time. We cannot prove that the same worms are remaining immature but that point is of less importance than the fact that moderate to large numbers of "new" worms are not reaching the adult state.

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RESPONSE OF CLINICAL CASES OF PARAGONIMUS KELLICOTTI IN CATS AND DOGS TO TREATMENT WITH ALBENDAZOLE.

C. R. MILLER, SmithKline Animal Health Products, 1600 Paoli Pike, West Chester, Pennsylvania.

Paragonimus kellicotti infections in dogs and cats have been reported by several investigators. Albendazole was reported to be effective in the treatment of this parasite in cats.* Clinical studies carried out by numerous investigators evaluated doses of 25 to 50 mg/kg daily for 7 to 20 days. When two days of negative fecal examinations were used as the end point for treatment the dosing lasted for about 15 days. Radiographic evidence, as well as negative fecal examinations showed a high rate of recovery from infection following treatment. In most cases, animals remained free of symptoms following treatment for as long as 18 months. Reinfections occurred in several animals.

A dose of 25 mg/kg body weight for 19-14 days or until the fecal examination becomes negative, shows promise in the therapy of Paragonimus kellicotti infections in cats and dogs.

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*Albendazole Therapy for Experimentally Induced Paragonimus kellicotti Infections in Cats. J. P. Dubey, M.V.Sc., et al.

Treatment of Canine Paragonimiasis with Albendazole. K. S. Todd, Jr., Ph.D., et al.

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THE EFFECT OF ALBENDAZOLE ON DICROCOELIUM DENDRITICUM IN SHEEP.

V. J. THEODORIDES and J. GEORGI, SmithKline Animal Health Products, West Chester, Pennsylvania, and New York State College of Veterinary Medicine, Cornell University, Ithaca, New York.

Twenty-six (26) adult sheep with natural patent infections of Dicrocoelium dendriticum were used in this experiment, One group of eight sheep was treated with 4.55% suspension of albendazole at 7.5 mg/kg b.w. The drug was administered intraruminally twice, at one week intervals. D. dendriticum was reduced by ca. 27% with a total recovery of 9,272 flukes at necropsy. A second group of eight sheep was treated with 20 mg/kg of albendazole. The drug was administered intraruminally once. There was a 98% D. dendriticum elimination, with 259 flukes recovered at necropsy. The ten control sheep treated intraruminally with albendazole suspending vehicle had at necropsy a total of 21,128 recovered flukes.

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UPDATE ON GUIDELINES FOR DEVELOPMENT OF CANINE ANTHELMINTICS.

R. E. BRADLEY, College of Veterinary Medicine, University of Florida, Gainesville, Florida.

A panel of 20 scientists was convened as an ad hoc committee in January, 1979. This committee membership is voluntary and the members pay their own expenses in order to remain independent. A first draft of the guidelines has been developed and distributed to the entire committee. It will be discussed at the AAVP meeting in Seattle, Washington at 4 p.m. on Monday, July 23, 1979. Constructive comments are solicited from all interested parties.

EVOLUTION OF SWINE ANTHELMINTICS.*

E. G. BATTE, School of Veterinary Medicine, North Carolina State University, Raleigh, North Carolina.

The control of internal parasites of swine has been the goal of parasitologists and swine producers. Some of the early anthelmintics required individual treatment of animals. The areca nut was given at the rate of 1/2 to 1 grain per pound body weight together with santonin at 1 to 4 grains per pig. The powdered areca nut being an irritant acted as a purgative for the expulsion of Ascarids. Benzene in 1 to 3 dram doses was recommended as effective. Individual treatment of young pigs with 1 to 5 grains of Calomel followed by castor oil was sufficient to dislodge the worms. Oil of chenopodium was given at a dose rate of 2 to 4 cc for a 100 pound animal followed by two fluid ounces of castor oil.

Intensive swine production required mass treatment rather than individual medication. Individual dosing of swine is difficult. Swine are noisy, dirty, hard to catch and hold and can bite viciously.

Sodium fluoride was the first anthelmintic used for mass medication of swine. One pound of sodium fluoride was mixed in 100 pounds dry feed and offered in the morning and evening. The efficacy was 95% against ascarids and 93% against stomach worms.

Cadmium oxide and cadmium anthranilate were found to be effective when fed for three days. Cadmium salts were more palatable, not as acutely toxic as sodium fluoride and could be fed in wet feeds. They could not be fed to animals to be slaughtered within 30 days because of tissue residue.

Piperazine has a good therapeutic index but a narrow spectrum of anthelmintic activity. It is effective only against the adult ascarid in the intestines.

Hygromycin B was the first anthelmintic used for mass medication of swine with a broad spectrum of activity. Multiple day feeding programs have been used with hygromycin B and pyrantel tartrate to control parasites and block liver migration of ascarids. Thiabendazole paste has been found to be highly effective and safe for treatment of Strongyloides in baby pigs.

Levamisole and dichlorvos are anthelmintics that are easy to use in mass medication. There is a broad spectrum of anthelmintic activity as label claims range from lungworms to swine kidneyworms.

There are some very interesting anthelmintics on the horizon. Albendazole, avermectin, cambendazole, fenbendazole, and mebendazole are being evaluated in laboratories throughout the world.

*Paper to be presented by K. Powers.

Tuesday, July 24, 1979

3:00 p.m. - Workshop on Guidelines for Swine Anthelmintics.

Moderator: R. Corwin.