PROCEEDINGS

25th

ANNUAL MEETING

THE

AMERICAN ASSOCIATION

OF

VETERINARY PARASITOLOGISTS

JULY 20-22, 1980
WASHINGTON, D.C.

SUNDAY, JULY 20 - Sheraton Washington Hotel, Colorado Room
SECTION A: PARASITES OF HORSES
PRESIDING OFFICER: N.F. BAKER
9:00 a.m.

A CASE OF "KUMRI" (EQUINE CEREBROSPINAL SETARIASIS) FROM THE UNITED STATES.

K. R. KAZACOS and H. C. FRAUENFELDER, School of Veterinary Medicine, Purdue University, West Lafayette, Indiana; and J. R. LICHTENFELS, Beltsville Agricultural Research Center, Beltsville, Maryland.

Equine cerebrospinal nematodiasis (CSN) due to Setaria sp. was diagnosed at necropsy in a 12-year-old Quarter Horse mare in Indiana. Previously, Strongylus vulgaris has been the only nematode identified in cases of equine CSN in North America. Setaria digitata is a well known cause of equine CSN in Asia, where it produces a condition of ataxia and paralysis in horses known as "Kumri", or "weak-back".

The mare in this case developed hind limb ataxia, and was admitted to the Large Animal Clinic, Purdue University, in lateral recumbency. The tail was hypotonic; the cervical panniculus response, patellar and triceps reflexes were absent; a crossed extensor reflex was present in the hind limbs. Blood parameters and cerebrospinal fluid analysis were normal. Despite supportive therapy, the mare's condition deteriorated, and she died on day 6 in a state of malignant hyperthermia (108F).

At necropsy, gross findings included multifocal small dark areas in the brain stem and medulla, fibrin tags on the liver capsule, and verminous arteritis of the cranial mesenteric artery (with S. vulgaris larvae present). Histologically, significant changes were present only in the first cervical spinal cord segment. These included widespread degeneration and a mixed inflammatory reaction involving both white and gray tracts; diffuse spongiosis; swollen and degenerating axons; hemorrhage; large malacic tracts, filled with macrophages and debris; and cross sections of a nematode parasite. No eosinophils were noted in the sections.

The nematode was 121u (esophageal region) to 134u (intestinal region) in body diameter, and had the following microscopic characteristics: the musculature was coelomyarian, in distinct dorsal and ventral fields; the intestinal cells were distinct, several, uninucleate and without a microvillous border; the lateral chords were broader at the base, protruded slightly inward, and had no associated cuticular projections or supporting structures. A tentative diagnosis of 4th stage male Setaria sp. was confirmed after comparison with serial sections of adult male and female S. labiatopapillosa in the National Parasite Collection, Beltsville, Md.

These findings indicate that a Setaria sp. present in North America can cause CSN in horses similar to that caused by S. digitata in horses in Asia. Circumstantial evidence of coincident central nervous system migration damage and verminous arteritis, therefore, should not be used to implicate S. vulgaris as the cause of equine CSN, in cases where no larvae are found and identified.

9:15 a.m.

THE PATHOGENESIS OF EQUINE ASCARIASIS.

H. M. CLAYTON, Department of Microbiology and Public Health, Michigan State University, East Lansing, Michigan.

Following monospecific infection of foals with Parascaris equorum bodyweight changes were monitored over a three month period. During this time weight gains were depressed by 50% compared with worm-free controls. Radioisotopic techniques were used to investigate the underlying pathophysiological disturbances.

Studies using ^{125}I-labelled albumin showed that infected foals had a lower total body albumin and serum albumin than worm-free controls. This was ascribed to a depression of albumin synthesis since there was no increase in albumin catabolism or protein leakage into the gut. Another indication of their inferior body composition was the fact that infected animals had a higher total body water/solids ratio, which was measured after injection of tritiated water.

Fluids labelled with ^{51}Cr-EDTA passed more slowly through the gastrointestinal tract in infected foals than controls, indicating some disturbance in gut motility.

9:30 a.m.

THE ANTHELMINTIC PROFILE OF PANACUR® (FENBENDAZOLE, FBZ).

D. DÜWEL, Hoechst AG, Helminthology/ D-6230 Frankfurt, Germany.

The paper sums up well-known and recently reported investigations of fenbendazole.

In HORSES the recommended dose of 5 mg FBZ/kg bwt. eliminates large and most of the small strongylids, oxyurids - and with 10 mg FBZ/kg - ascarids between more than 90 up to 100%. More interesting is the high efficacy of 5 x 7.5 mg/kg which influences the migrating stages of Str. edentatus and Str. vulgaris (80 %) and also mucosal stages of small strongylids (>95%). Higher dosages also exert a certain and far-reaching influence on Strongyloides westeri, Habronema spp., Parafilaria multipapillosa and Acanthocephala spp. The extremely good tolerance of FBZ makes higher dosages still non-hazardous for the horse - and also other animals - to be treated.

The usual, but economically important nematodes (Trichostrongylidae, Strongylidae, including lungworms) of RUMINANTS are reliably eliminated, both immature and adult, after single treatment with 5-7.5 mg/kg bwt. Underlined should be the activity of FBZ >70% to >95% with the same dosage in inhibited O. ostertagi and other nematodes as Haemonchus, Trichostrongylus, Cooperia and D. viviparus. Immature and adult protostrongylids in small ruminants are influenced >90% to 100% with 1 x 10 mg/kg/.

Repeated reports have been made on the high efficacy of FBZ on PIG nematodes, including Stephanurus dentatus, Metastrongylus spp. and also immature Trichuris suis (>90% with a total of 5 mg/kg in 15 days).

In CARNIVORES treatment with 5 x 20 or 3 x 50 mg FBZ/kg bwt. cures infections by hookworms, ascarids, whipworms, and Taenia spp. Angiostrongylus spp. and Aelurostrongylus spp. which are difficult to influence therapeutically are eliminated with 6 x 5 mg/kg bwt. Inhibited larvae of Toxocara and Ancylostoma in pregnant bitches are killed by continuous treatment in the last third part of pregnancy: worm-free whelps will be born.

The neutral taste and the high tolerability of many times over the therapeutic dose of FBZ makes it easy to deworm WILD and ZOO ANIMALS, including such sensitive animals as roe deer or Saimiri, also when self-uptaking medicated feed. The anthelmintic success corresponds in general to the results of the respective domestic animals. It has been possible for the first time to treat successfully, e.g. Elaphostrongylus cervi in red deer or Prosthenorchis spp. and Bertiella spp. in monkeys.

In POULTRY immature and adult nematodes of Ascaridia, Amidostomum, Heterakis Syngamus and Capillaria are eliminated at almost 100% by 60-100 ppm FBZ in the feed for 3-6 days. Also, breeding colonies of LABORATORY ANIMALS can be dewormed with 100 ppm (Syphacia spec.) or 25-50 ppm (Passalurus ambiguus) each on 5 days -other helminths included. Mention should be also made of the high efficacy of FBZ on Echinococcus alveolaris and E. multilocularis in long-term treatment or on Trichinella spiralis, including encysted stages in a dose of only 500 ppm for 5 days, both in model animals.

FBZ not only acts on immature and adult worms including inhibited stages, it also possesses an ovicidal and larvicidal activity.

The criteria for selecting an anthelmintic nowadays depends not only on a broad spectrum against generally distributed and economically important helminths, but also on additional data such as, e.g. Applicability, Tolerance, Economy in use, Residues, Efficacy on 'problem helminths'. Panacur gives a positive answer to these points as anthelmintic mainly against nematodes but also against cestodes and trematodes. Additional examples and data will be given.

Panacur® - reg. trade mark of Hoechst AG.

9:45 a.m.

CLINICAL TRIALS WITH FENBENDAZOLE AND TRICHLORFON IN HORSES[a].

J. A. DiPIETRO and K. S. TODD, JR., College of Veterinary Medicine, University of Illinois, Urbana, Illinois.

Clinical trials were done on 50 horses of various sex, breed, and age with naturally acquired parasitic infections. The horses were treated with 5 mg/kg fenbendazole and 40 mg/kg trichlorfon sequentially via stomach tube. McMaster's egg per gram counts (EPG) were done on fecal samples taken directly from the rectum immediately prior to treatment and 7 days post-treatment. Daily examination of the feces for larvae of Gasterophilus species and observation of the horses for signs of adverse reactions were carried out for 7 days post-treatment. The mean pretreatment stongyle EPG was 1215 (0-5050) and the mean pretreatment Parascaris equirum EPG was 23 (0-1050). The mean post-treatment strongyle and P. equorum EPG was 52 (0-450) and 18 (0-900), respectively. Passage of Gasterophilus species larvae was noted in 8 horses during the post-treatment period. An adverse reaction occurred in 1 mare out of the 50 horses treated. The mare became lethargic and anorexic 1 day after treatment and remained so through day 5 post-treatment. No treatment was instituted and full recovery occurred by day 7 post-treatment.

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[a] This project was supported in part by a grant from Hoechst-Roussel Pharmaceuticals, Inc., Somerville, New Jersey.

10:00 a.m.

THE EVALUATION OF IVERMECTIN AS AN ANTIPARASITIC AGENT IN HORSES.

J. R. EGERTON and E. S. BROKKEN, Merck Institute, Rahway, New Jersey.

The antiparasitic efficacy of ivermectin was examined in naturally infected horses following subcutaneous injection. Initially the evaluation involved comparisons of results using the controlled trial method with an abbreviated self-contained critical trial. Follow-up was done using only the controlled method as it was $\simeq 4.5$ times less labor intensive than the critical method.

In the initial range-finding experiment 15 horses were treated with 0.02, 0.1 or 0.5 mg ivermectin/kg s.c. Strongylus vulgaris, S. equinus, Gastrophilus nasalis and G. intestinalis were nearly completely eliminated by 0.02 mg/kg. Adult Cyathostomum pateratum, C. catinatum, Cylicocyclus nassatus, C. leptostomus, Cylicostephanus minutus, C. longibursatus, L_4 Oxyuris equi, L_5 Parascaris equorum and L_4 small strongyles were effectively removed (> 95% reduction of each species) by 0.1 mg ivermectin/kg. Microfilariae of Onchocerca cervicalis were not recovered from $\simeq 26$ cm^2 of periumbilical skin from 10 horses treated at 0.1 or 0.5 mg/kg whereas 4/5 untreated control horses and 5/5 horses treated at 0.02 mg/kg were positive for skin microfilariae at necropsy 7 days post-treatment. Cylicostephanusgoldi required more than 0.1 mg/kg for good control and Cylicocyclus insigne, while poorly represented, was recovered in small numbers from some horses treated with 0.5 mg/kg.

Fifteen additional horses treated at 0.1, 0.2 or 0.4 mg/kg had only Cylicocyclus minutus (2 horses), Cylicocyclus insigne (3 horses) and 4th stage small strongyles (4 horses) remaining at necropsy. Five comparable untreated control horses harbored 20 species of small strongyles, 5 species of large strongyles and 2 species of bots.

Data from these two experiments will be illustrated.

10:15 a.m.

EFFICIENCY AND DOSE TITRATION OF INTRAMUSCULARLY INOCULATED IVERMECTIN AGAINST ENDOPARASITES OF HORSES.

T. R. KLEI, B. J. TORBERT and R. OCHOA, Department of Veterinary Science, Louisiana State University, Baton Rouge, Louisiana.

The controlled test method was used to evaluate the antiparasitic efficacy of intramuscularly inoculated 22,23-dihydroavermectin B_1 (ivermectin) against gastrointestinal parasites of horses. Parasite infections were naturally acquired in southern Louisiana. Dose levels of drug tested were 0.2 mg/kg, 0.3 mg/kg, and 0.5 mg/kg.

Ivermectin at all dose levels tested had an efficacy greater than 99% against Gasterophilus intestinalis larvae, Trichostrongylus axei, Strongylus vulgaris, S. edentatus, 16 species of small strongyles, small strongyle larvae and Onchocerca cervicalis microfilariae. Ivermectin showed an efficacy of greater than 98% against Oxyuris equi larvae. Efficacy against O. equi adults ranged between 87% and 91%. Although animals were less uniformly infected with Habronema sp. larvae, G. nasalis larvae, Parascaris equorum, Anoplocephala perfoliata, S. equinus, and 10 small strongyle species, observations also indicate that the drug was highly effective against these species. The efficacy of ivermectin against adult Setaria equina varied with dose level from 80% to 88% and appeared to increase with increasing dose levels. No gross or clinical reactions were observed in treated animals.

10:30 a.m.
BREAK

10:45 a.m.

RESISTANCE OF EQUINE PARASITES TO ANTHELMINTICS.

J. H. DRUDGE and E. T. LYONS, Department of Veterinary Science, University of Kentucky, Lexington, Kentucky.

The problem of strongyle resistance to anthelmintics has been recognized in central Kentucky since the mid 1950's. There was evidence in clinical tests that populations or strains of both large and small strongyles were resistant to phenothiazine, which led to the development of phenothiazine/piperazine mixtures for effective control.

Thiabendazole's initial, unqualified effectiveness for strongyle control was short-lived. Less than 3 years usage was required for the selection of a resistant population on a farm designated "B". This population has been investigated extensively since 1962. Critical tests data on this strain, isolated in a departmental band of horses, reveal the resistance is limited to 5 species of small strongyles. Also, the resistance has been manifested against 5 of 7 benzimidazoles (TBZ, MBZ, CBZ, FBZ, OFZ, but not OBZ and ABZ). Likewise, febantel and tioxidazole do not effectively remove these 5 species of small strongyles, but pyrantel pamoate and ivermectins are efficacious against the entire spectrum of small strongyles. Concurrent on-going trials on Farm B reveal PTZ-PPZ Complex, PTZ-PPZ-trichlorfon mixture, and TBZ-PPZ mixture have maintained effective strongyle activity for periods of 18, 14, and 13 years, respectively.

Clinical tests on several other central Kentucky farms indicate the resistance problem is widespread. The data are in support of the foregoing revelations from the critical tests on population B. These clinical trials also indicate that dichlorvos is active against benzimidazole-resistant strongyles and some strains of small strongyles exhibit a cross-resistance between the benzimidazoles and phenothiazine.

11:15 a.m.

AN IN VITRO TEST FOR THE DETECTION OF BENZIMIDAZOLE RESISTANCE IN EQUINE STRONGYLES

T. W. SCHILLHORN VAN VEEN and H. M. CLAYTON, Veterinary Clinical Center, Michigan State University, East Lansing, Michigan.

In the horse, resistance to anthelmintics of the benzimidazole group has been shown to occur in five species of small strongyles. Previous studies have used either critical anthelmintic trials or post-treatment depression of fecal egg counts to determine whether resistant strains were present. In ruminants, the occurrence of benzimidazole resistance has been studied using in vitro egg-hatchability tests. This paper will describe a simple in vitro test which is suitable for the detection of resistant parasites in the horse.

Strongyle eggs from fresh horse feces are incubated in solutions of pure thiabendazole using concentrations in the range of 0.1% to 0.001%. After five days, the development of eggs incubated with thiabendazole is compared with that of eggs incubated in 0.1% saline. In benzimidazole-susceptible strains embryonation is inhibited by the anthelmintic.

This in vitro test was used on strongyle eggs from a number of horse farms in Michigan during the period March to July, 1980. The results will be discussed.

11:30 a.m.

AN EVALUATION OF SEVEN EQUINE ANTHELMINTICS IN OHIO.

R. P. HERD, T. B. MILLER and A. A. GABEL, College of Veterinary Medicine, The Ohio State University, Columbus, Ohio.

The study was designed to compare the efficiency of 7 commonly used equine anthelmintics, including 4 benzimidazole (BZD) and 3 non-BZD drugs, using a Latin square design on 2 large commercial horse farms in Ohio. The 7 anthelmintics were graded 0-100% on their ability to reduce fecal egg counts to less than 50 epg at both 2 and 4 weeks post-treatment. This was considered to give a very realistic comparison of the drugs, since the main purpose of a control program is to reduce fecal egg output and pasture contamination to safe levels.

Results with 100 mares and yearlings on one farm indicated that there was a severe BZD-resistance problem. The non -BZD drugs, dichlorvos (Equigard) and pyrantel pamoate (Strongid T) achieved a rating of 80-100% and were significantly better than other drugs. A phenothiazine-piperazine compound (Parvex Plus) had the next best rating (60-77%). The BZD drugs, cambendazole (Camvet), fenbendazole (Panacur), mebendazole (Telmin), and febantel (Rintal) all gave poor results (13-58%).

Both BDZ and non-BDZ drugs performed well with 50 yearlings on another farm where there was no apparent resistance problem. On this farm, there was no significant difference between drugs, which all rated between 67-100%. With all drugs, substantial rises in egg counts were seen 6-8 weeks post-treatment. These increases were attributed to re-infection with small strongyles, which have a prepatent period as short as 5 weeks. Larval cultures showed that small strongyles were responsible for 100% of the egg count in most instances.

11:45 a.m.

GENERAL DISCUSSION

12:00

LUNCH

SUNDAY, JULY 20 - Sheraton Washington Hotel, Colorado Room
SECTION A: PARASITES OF DOGS AND CATS
PRESIDING OFFICER: E.L. ROBERSON
1:00 p.m.

UPDATE ON HEARTWORM DIAGNOSIS AND CONTROL

GILBERT F. OTTO, Zoology Department, University of Maryland, College Park, Maryland.

Canine heartworm disease continues to spread both west and north from the southeastern coastal areas of United States. It is now a problem in northern California, southern Canada and some mountain valleys of West Virginia and Colorado. A similar extension is occurring in eastern Australia, southward from the northern tropics. We have just learned that some developing stages in mosquitoes can tolerate temperatures below 60°F.

Except for the caval syndrome, it is commonly assumed that heartworm infection induces a slowly developing chronic disease. However, recent studies at the University of Georgia and at the University of Pennsylvania have demonstrated vascular lesions within six months after infection with pulmonary hypertension within a year. Fortunately, there is complete remission following effective adulticidal therapy. Studies at the University of Minnesota reveal specifically that there may be remission of the kidney lesions, including those resulting from the adulticide, thiacetarsamide.

Measurements of the apical branch of the pulmonary artery, visualized on lateral radiographs, appear to offer a more finite index of infection than the usually recognized enlarged pulmonary conus or enlarged right ventricle.

Shock which has been recognized following the administration of diethylcarbamazine to dogs with heavy microfilaremia has now been experimentally induced in all dogs regardless of the level of parasitemia. Thiacetarsamide has been re-evaluated. It continues to be the adulticide of choice but is not consistently active against the very young adults. Possible new drugs are under study against each of the three phases of the parasite in the dog, viz. the infective stages, the adults, and the microfilariae.

2:00 p.m.

OBSERVATIONS ON THE FOCAL NATURE OF HEARTWORM TRANSMISSION IN A HYPOENDEMIC AREA.

R. SCHOLTENS, College of Veterinary Medicine, University of Tennessee, Knoxville, Tennessee.

The premise that the distribution and incidence of vector-borne diseases is influenced largely by the traits of local vectors motivated some shoeleather epidemiology of dirofilariasis in East Tennessee. The resulting data indicate widely varying infection rates with an overall prevalence of about 5 percent, that cases are often clustered and occur in small geographic foci, and that wooded environments may be favorable transmission sites. The conclusions fostered are that there are epidemiologic similarities between canine heartworms and human malaria as it existed in the United States early in this century, that, as with malaria, the number of mosquito species capable of being infected in the laboratory is greater than the limited number responsible for natural transmission, and that the available scientific literature offers little evidence of what mosquito species are the principal natural vectors of dog heartworms.

2:15 p.m.

CORRELATION OF LENGTH AND WIDTH IN SPECIATION OF CANINE MICROFILARIA.

S. E. PRATT and R. M. CORWIN, College of Veterinary Medicine, University of Missouri-Columbia, Columbia, Missouri.

The prevalence of Dirofilaria immitis and Dipetalonema reconditum in Missouri dogs was investigated by a statewide veterinary mail survey and a study of shelter dogs from central Missouri and Mississippi River communities. Of 493 shelter dogs tested using the modified Knott's, 23 (4.7%) were positive for D. immitis, 23 (4.7%) for D. reconditum, and 2 (0.4%) were mixed infections. A higher prevalence rate of both D. immitis (9.4%) and D. reconditum (6.3%) was seen in shelter dogs from the Mississippi River communities than in those from central Missouri (1.7% for D. immitis, 3.7% for D. reconditum). The mf of D. immitis in shelter dogs ranged in length from 255 to 343 micrometers (μm) (mean=314) and in width from 5.0 to 7.5 μm (mean=6.5); those of D. reconditum ranged in length from 238 to 295 μm (mean=257) and in width from 3.2 to 6.5 μm (mean=4.9). Buttonhook tails were seen in 41% of the Dipetalonema mf. In the final analysis, shape of anterior ends was considered the most reliable criterion for differentiation.

The veterinary survey found D. immitis in 447 of 11,834 (3.8%) dogs, D. reconditum in 14 (0.1%), and 8 (<0.1%) had microfilariae (mf) of both species. Filtration and the modified Knott's techniques were used most frequently.

2:30 p.m.

A SURVEILLANCE AND CONTROL PROGRAM FOR HYDATID DISEASE IN UTAH.

F. L. ANDERSEN, Department of Zoology, Brigham Young University, Provo, Utah.

Hydatid disease is endemic in at least two counties in Utah, and more surgical cases for human hydatidosis have occurred in Utah (39) than in any other state in the conterminal United States. Since 1971, a correlated effort between Brigham Young University, the Utah State Department of Health, and the Center for Disease Control, Atlanta, has been directed toward the identification of the extent of this problem, just which factors influence the spread and distribution of the disease in this region, and which measures might be implemented to prevent and control the condition.

When the program first began, 27% of the dogs in small sheep-raising communities in central Utah were infected with hydatid tapeworms, whereas the prevalence in 1979 had dropped to less than 5%. Over the same period of time, the percentage of sheep which harbored hydatid cysts at necropsy declined from 10% to 3%.

The main factors which have contributed to this decline are (1) an intensive educational program, (2) marked cooperative effort by local community leaders and health educators, (3) the holding of public health clinics for detection of asymptomatic cases of hydatid disease in humans, and of field clinics for detection of hydatid tapeworms in dogs, (4) construction of covers for disposal pits for dead sheep discarded at community dumping grounds, and (5) mass treatment programs for sheep dogs within endemic regions.

3:00 p.m.
BREAK

3:15 p.m.

ACTIVITY OF FENBENDAZOLE AGAINST SOMATIC STAGES OF ASCARIDS AND HOOKWORMS IN PREGNANT BITCHES.

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

Fifteen laboratory-reared bitches, with known breeding dates, were administered 5,000 embryonated eggs of Toxocara canis orally and 10,000 viable larvae of Ancylostoma caninum subcutaneously on each of 3 occasions during pregnancy, the 5th-14th day, 35th day, and 60th day. Bitches were assigned to 3 groups of 5 each. Two groups were treated with granulated fenbendazole (Panacur) at a daily dosage of 50 mg/kg of body weight --- Group 1 from the 40th day of pregnancy through 2 weeks after whelping (av. of 37 daily treatments/dog), Group 2 from the 40th day of pregnancy to the day of whelping (av. of 24 daily treatments/dog). Bitches in Group 3 served as infected non-medicated controls. Pups were allowed to nurse until necropsied at 5 weeks of age. Average ascarid burdens/pup in Gp's. 1, 2, and 3 were 42, 145 and 399, respectively, and hookworm burdens were <1, 6, and 51. Reductions in worm burdens of long-term treated and short-term treated groups were 90% and 64% for ascarids and 98% and 88% for hookworms, respectively. Clinical illness associated with ascarids was prevented (long-term treatment group) or reduced (short-term treatment group) in comparison with controls.

3:30 p.m.

PUBLIC HEALTH ASPECTS OF TOXOCARIASIS.

P. M. SCHANTZ, Bureau of Epidemiology, Center for Disease Control, Atlanta, Georgia.

Ingestion of soil containing eggs of the common roundworms of dogs and cats, Toxocara spp., results in infection and in some cases severe disease in human beings. This is not a new disease, simply one about which the public and the medical profession are becoming more aware. The development of a sensitive and specific serologic test, the enzyme-linked immunosorbent assay, has provided a useful clinical tool for physicians to confirm their clinical impressions and for epidemiologic studies to define the prevalence and distribution of toxocaral infections. Serologic testing of 8,590 serum specimens collected from a probability sample of the civilian population of the United States revealed an overall serologic prevalence at a diagnostic titer of 2.8%. Seroprevalence was higher among children under 15 years of age than among older persons; higher in the South and Northeast than in the West and Middlewest; higher in residents of rural areas than in those of urban areas; higher in low income households than in high income households; and apparently independent of these other factors, higher in black than in white or other races. Extrapolation from these sampled findings to the estimated total United States population suggested that approximately 6,000,000 persons had been infected with toxocariasis at the time of the study. Several recent clinical studies have demonstrated that visceral larval migrans and ocular larval migrans are diagnosed frequently in certain populations. These clinical observations are discussed in terms of the risk factors associated with human infection and the widespread occurrence of dogs in American households. The role of veterinarians in helping to prevent infection in families of dog owners will be reviewed.

3:45 p.m.

FILAROIDES (OSLERUS) OSLERI AND FILAROIDES HIRTHI IN AUSTRALIAN DOGS.

J. D. DUNSMORE, School of Veterinary Studies, Murdoch University, Murdoch, Western Australia.

The presence of Filaroides osleri in domestic dogs in Australia has been known for many years, but its prevalence is very low. During recent years a very high level of infection has been found in dingoes and feral dogs. There is now sufficient knowledge of the life cycle of F. osleri to enable a suggestion to be made as to why the prevalence in domestic dogs remains very low while high in feral dogs despite the fact there is no real ecological separation between the two classes of dogs.

Filaroides hirthi has recently been found in several laboratory dog colonies in Australia and a single transmission gave results identical to those reported in the United States of America. In addition, a parasite very like it, and probably the same, has been found asymptomatically in several Boxer dogs in Western Australia. There is no evidence to connect the Boxers in Western Australia with the laboratory Beagles in other states.

4:00 p.m.

SERUM PROTEINS IN NORMAL CATS AND CATS INFECTED WITH AELUROSTRONGYLUS ABSTRUSUS.

J. A. BARSANTI and J. HUBBELL, College of Veterinary Medicine, University of Georgia, Athens, Georgia.

Serum proteins were evaluated by cellulose acetate electrophoresis in cats prior to and every 2 weeks for 24 weeks after oral infection with third stage larvae of Aelurostrongylus abstrusus. Evaluation of electrophoretograms was standardized by determination of electrophoretic migration ratios. Six fractions of serum proteins were consistently identified: albumin and α_1, α_2, β_1, β_2 and γ-globulin. Relative and absolute concentrations of each serum protein fraction were determined. The only changes found were a decrease in concentration of α-globulins and an increase in concentration of β_1 globulins. These changes were mild, however, so that the concentrations for infected cats were still within 1 SD of the control concentrations. Apparently serum elecrophoresis is not a useful diagnostic test for aelurostrongylosis.

4:15 p.m.

TRIXACARIASIS IN GUINEA PIGS.

A. ZAJAC, C. S. F. WILLIAMS and J. F. WILLIAMS, Department of Microbiology and Public Health, Michigan State University, East Lansing, Michigan.

A two-year-old crested guinea pig boar was presented to the Michigan State University Veterinary Clinical Center with marked alopecia on the head and neck and thinning of the hair on the shoulders and sides. In addition, intense pruritis and signs of CNS disturbance were noted. Closer examination revealed the presence of scabs of congealed exudate similar to those seen in cases of sarcoptic mange. Skin scrapings produced many small sarcoptiform mites in all stages of development. Morphologic characteristics of the mites and the histopathologic reactions in guinea pig skin were consistent with descriptions of Trixacarus caviae. Four additional guinea pigs from the same herd showing clinically similar signs responded to treatment with Gammex® (Lindane). However, despite repeated skin scrapings no mites could be detected.

Although T. caviae has been described in several outbreaks of acariasis in Europe, the mite has been reported only once in the U.S. Examination of material from other guinea pigs with the recognizable clinical syndrome, as well as discussions with veterinarians from several states indicate that infestation of guinea pigs with T. caviae in this country may be more prevalent than the literature indicates. We feel that the mite may frequently be missed because of its small size and the difficulty associated with detecting low concentrations of mites which may be present even in severely affected animals. Unfamiliarity with T. caviae may also lead to the erroneous identification of the mite as Sarcoptes or Notoedres.

4:30 p.m.
GENERAL DISCUSSION

5:00 p.m.
BUSINESS MEETING, COLORADO ROOM

6:00 pm
HOSPITALITY HOUR, PRESIDENT's ROOM

SUNDAY, JULY 20 - Sheraton Washington Hotel, Wisconsin Room
SECTION B: PARASITES OF RUMINANTS
PRESIDING OFFICER: K.D. MURRELL
9:00 a.m.

THE WINTER TICK, DERMACENTOR ALBIPICTUS (PACKARD), AS AN EXPERIMENTAL VECTOR OF EQUINE AND BOVINE BABESIOSIS.

D. STILLER, W. M. FRERICHS and K. L. KUTTLER, Science and Education Administration, Animal Parasitology Institute, Beltsville, Maryland.

Although the winter tick, Dermacentor albipictus, is a common parasite of horses and cattle and is widely distributed in North America, its role as a potential vector of equine and bovine babesiosis has been little studied. Experiments to assess the vector competence of the inornate form of D. albipictus (Texas strain) for Babesia caballi revealed that: (1) up to 80% of female ticks fed on parasitemic ponies and held at 18 or 26 C became infected, as demonstrated by the presence of parasites in Giemsa-stained smears of tick hemolymph; (2) the F_1 progeny of infected females were infected transovarially and transmitted the infection when test-fed on susceptible ponies; (3) male ticks transmitted the infection after delayed transfer from infected to susceptible hosts; and (4) developing parasites were seen in the hemolymph of transovarially-infected males which had infested a burro for 64 hours; these males had ecdysed in vitro 14 days prior to infesting the burro. The sequence of parasite transmission by different tick stages, parasite development in ticks held at low temperature, and the vector competence for B. caballi of other geographic strains of the tick are being studied. In a test of the experimental vector competence of D. albipictus (Texas strain) for the bovine piroplasm Babesia bigemina, the parasite was not detected in the hemolymph of 108 females fed on a splenectomized calf with a maximum parasitemia of 8.3%. The F_1 progeny from 58 of these females are being test-fed on susceptible calves.

9:15 a.m.

CHARACTERIZATION OF A TICK STABILATE OF BABESIA BOVIS.

T. M. CRAIG and G. G. WAGNER, College of Veterinary Medicine, Texas A & M University, College Station, Texas.

A cryopreserved, tick origin material containing infective Babesia bovis was prepared in an attempt to characterize the infection in normal adult cattle. Adult female Boophilus microplus were allowed to feed to repletion on Babesia bovis-infected calves, then placed in humidity chambers of 85% RH and 27 C where they were allowed to oviposit. At the completion of egg production eggs were allocated into 2 gm masses until hatching. After hatching, the larvae were held at 20 C, 80% RH for 13 days then 37 C, 80% RH for 80 hours. They were then disrupted in a Ten-Broeck homogenizer and chitinous material separated by a Ficoll/hypaque density gradient (1.077). The supernatant material was pooled and mixed with equal volumes of 20% DMSO, 35%, bovine serum albumen MEM for freezing. The material was placed in glass vials in a solid CO_2 chamber overnight and transfered to liquid N_2 for storage.

Sixteen mature mixed breed cows were inoculated i.v. with one of the following: 1 ml killed stabilate; 10 ml stabilate, 5 ml stabilate or 1 ml stabilate. All of the cows given 10 ml of stabilate became infected and 3 of 4 died of a B. bovis infection. None of the cattle given 1 ml killed material became infected or showed any serological reaction to a B. bovis indirect fluorescent antibody (IFA) test. However, 2 of 4 cows given 5 ml and 1 of 4 cows given 1 ml of material failed to either demonstrate clinical signs of disease or evidence of infection. No differences were observed between the effects on cattle receiving 1 ml or 5 ml stabilate. Non-reacting cattle rechallenged with the same material proved to be fully susceptible to infection, whereas those which recovered from the initial infection were resistant to disease. The reason for failure to induce the primary infection is unknown.

9:30 a.m.

BIOCHEMICAL PARAMETERS OF BOVINE BABESIOSIS.

G. S. ELISSALDE, M. H. ELISSALDE, G. G. WAGNER and T. M. CRAIG, College of Veterinary Medicine, Texas A & M University, College Station, Texas.

Twelve of 16 mature cows of mixed breeds were infected, i.v., with 1 to 10 ml of ground up tick (tissue) stabilate (GUTS) infected with Babesis bovis (syn. argentina). The remaining four animals that served as controls were dosed with heat-inactivated GUTS.

The infected cows were designated as follows: 1. a group that died (D), 2. a group that lived but were significantly ill (SI) with packed cell volumes (PCV) less than 20% during the course of the disease, and 3. a group that lived that were not significantly ill (NSI) whose PCVs were greater than 20% during the course of the disease.

Serum samples were obtained approximately every other day from day minus 2 through day 35 post infection (P.I.). Clinical biochemistries assayed included alkaline phosphatase (SAP), cholesterol, creatinine, lactic dehydrogenase (LDH), cholinesterase, creatine phosphokinase (CPK), blood urea nitrogen (BUN), uric acid and serum glutamic oxaloacetic transaminase (SGOT, aspartate amino transferase).

Data were statistically analyzed for differences between means at the $p = .05$ level. Significant differences began to appear between groups at about day 10 P.I. By day 35 P.I. BUN, SAP and uric acid remained significantly different.

9:45 a.m.

EFFECT OF ANAPLASMA MARGINALE INFECTION UPON BLOOD GASES AND ELECTROLYTES IN SPLENECTOMIZED CALVES.

P. C. ALLEN and K. L. KUTTLER, Science and Education Administration, Animal Parasitology Institute, Beltsville, Maryland.

Blood gases, pH and electrolytes were measured in splenectomized calves (6-10 mo. old) infected with Anaplasma marginale and compared to values obtained from uninfected calves and calves non-fatally infected with Eperythrozoon wenyoni. At anemic crisis the blood hemoglobin and oxygen contents of all infected calves were significantly lower than in controls. Calves fatally infected with A. marginale (AMF) as well as those infected with E. wenyoni (EWS) had significantly lowered blood pH, HCO_3^-/H_2CO_3 ratios, HCO_3^- concentration and higher anion gaps than control calves or calves surviving A. marginale infection (AMS). However, only AMF calves additionally exhibited significantly lower plasma K^+ and lower reticulocytosis. It is concluded that mortality in A. marginale infections is associated with uncompensated metabolic acidosis complicated by low plasma K^+ and lack of reticulocytosis.

10:00 a.m.

EFFECTS OF MAJOR STOMACH COMPONENTS FROM UNINFECTED CALVES ON MIGRATION OF LARVAE OF OSTERTAGIA OSTERTAGI IN VITRO.

FRANK STRINGFELLOW, Science and Education Administration, Animal Parasitology Institute, Beltsville, Maryland.

The present study compared the response of both sheathed and exsheathed larvae of Ostertagia ostertagi to selected components of calf abomasa and its contents with an improved bioassay. An analysis was made of major components of the gastric contents from uninfected calves. Components of the gastric contents were incorporated into agar blocks in physiological concentrations. Sheathed and exsheathed larvae of O. ostertagi were bioassayed to determine if they responded to any of the components. The data indicated: 1. Sheathed and exsheathed larvae of O. ostertagi migrated similarly; 2. Sheathed and exsheathed larvae of O. ostertagi were significantly repelled by gastric contents. Exsheathed larvae responded significantly less to chloride ion than to its control when it was the test component. Exsheathed larvae of O. ostertagi responded significantly to one-tenth molar sodium bicarbonate. Neither sheathed nor exsheathed larvae responded significantly to sodium ion. It was not technically feasible to determine whether the exsheathed larvae responded to bicarbonate ion or carbon dioxide with the present bioassay. One-tenth molar sodium biocarbonate produced a rising pH with time. Thus, it was the capacity of the 0.1 M $NaHCO_3$ agar block to generate a pH changing to the alkaline side which elicited a significant response. The present studies may explain how O. ostertagi larvae localize only in the abomasum. The larvae encounter the repellent in the gastric contents; and, possibly, they are driven out of it into the tissue.

10:15 a.m.

IN VITRO DEVELOPMENT OF OESOPHAGOSTOMUM RADIATUM, THE NODULAR WORM OF CATTLE, TO YOUNG ADULTS.

F. W. DOUVRES, Science and Education Administration, Animal Parasitology Institute, Beltsville, Maryland.

Advanced stages of Oesophagostomum radiatum were grown from exsheathed infective larvae in complex cell-free medium API-I (Douvres and Malakatis, 1977) when used alone or supplemented with a bovine heme compound (Filde's reagent or hemin), with appropriate applications of reducing agents, gas phases of 5% carbon dioxide in air or nitrogen and 85% nitrogen/5% oxygen/10% carbon dioxide, and pH of 6.4 to 6.8, in roller bottles. Based on culture periods of up to 46 days, O. radiatum larvae developed to the fourth molt in medium API-I, with and without heme compound. Development to young adult males and females was obtained as early as 25 to 34 days. The optimal culture system for development of this stage required medium API-I supplemented with 20 mM glutathione (reduced) for the first 7 days, followed by non-supplemented medium for 6 or 7 days and thereafter medium supplemented with Filde's reagent which contained hemin concentrations of 48 µg to 96 ug/ml medium. Beginning with an inoculum of 40,000 to 80,000 O. radiatum larvae, this system produced maximal yields of 100% advanced third stage by day 7, 65% to 90% fourth stage by days 15 to 21, and less than 1% young adults by days 25 to 46.

10:30 BREAK

10:45 a.m.

A COMPARISON OF ANTHELMINTIC EFFICIENCY OF OXFENDAZOLE AND ALBENDAZOLE WITH THIABENDAZOLE AND LEVAMISOLE IN DOMESTIC LAMBS.

R. C. BERGSTROM, College of Agriculture and Agricultural Experiment Station, University of Wyoming, Laramie, Wyoming.

Several new benzimidazole compounds have shown a broad spectrum of activity/lethality against various helminths common to sheep and cattle. Oxfendazole in a 2.26% suspension was used at a dosage rate of 5 mg/kg body weight in lambs, ewes and rams in order to assess percent efficacy against common helminths of the gastrointestinal tract and associated organs. Three trials were conducted as follows: Fifty crossbred Suffolk-Rambouillet lambs 4-6 months of age with 25 treated and 25 maintained as untreated controls. Fifty crossbred and Rambouillet ewes, 3 years-aged with 25 treated and 25 as controls and 50 Rambouillet rams under the same treatment regime. Pretreatment fecal analyses indicated the lambs carried from 0-22 with a mean of 3 eggs per gram of feces. Helminth species were Ostertagia sp., Trichostrongylus sp. and Nematodirus sp. (probably spathiger). Ewes carried the species indicated for the lambs plus Marshallagia marshalli, Chabertia sp., Trichuris sp. and the tapeworm, Moniezia sp. (ewes 2-70, mean 12 e.p.g.). Rams hosted the species shown for the ewes plus Strongyloides sp. (papillosus) with a range of 18-250, mean 76 e.p.g. Oxfendazole was effective in decreasing the egg numbers and presumably the adult helminths of lambs, ewes and rams for a 14-day period. Post-treatment (day 14) egg counts were zero for all worm species named except for Strongyloides sp. Efficacy against the latter helminth species was highly variable, ranging from 0-99%. In the fecal analyses of the rams, some Strongyloides sp. egg counts actually increased within the 2-week period.

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11:00 a.m.

EFFICACY OF IVERMECTIN AGAINST TICKS ON CATTLE

C.A. WILKINS, J. CONROY, P. HO, W. O'SHANNY, Merck Institute for Therapeutic Research, Rahway, New Jersey

The efficacy of ivermectin against ticks and mites on laboratory animals was recently reported by Egerton et al. (Brit. Vet. Jnl.) and Wilkins et al. (in press). Ivermectin is a macrocyclic lactone produced by Streptomyces avermitilis which exhibits extraordinarily potent antiparasitic activity. Parenteral treatment of cattle with ivermectin showed activity against four species of ticks at levels of .2 mg/kg and .5 mg/kg. Trials in the guinea pig model with Rhipicephalus sanguineus demonstrated that the engorged bodyweight of ticks from animals treated with ivermectin were greatly reduced and that the period of engorgement was prolonged. These findings have been confirmed in cattle using two species of ticks. In probe trials on limited numbers of cattle, the following results were obtained:

Tick species	Level of Treatment	% Efficacy of ivermectin*
Dermacentor albipictus	.2 mg/kg	100%
	.5 mg/kg	100%
Boophilus decoloratus	.2 mg/kg	63%
	.5 mg/kg	100%
Amblyomma americanum	.2 mg/kg	100%
Hyalomma anatolicum	.2 mg/kg	70%

*Using the E.R. method of Drummond.

11:15 a.m.

PREVALENCE OF THELAZIASIS IN NORTH CAROLINA CATTLE.

D. J. MONCOL and DAVID KRADEL, School of Veterinary Medicine, North Carolina State University, Raleigh, North Carolina.

Observations of 752 bovine eyes collected from 24 counties in North Carolina reveal an infection level of 10.6%. Only nine counties yielded positive cases. Two counties (Rowan and Guilford) had the highest prevalence, 38.5% and 37.5%, respectively.

Thelazia skrjabini was observed in 52.5% of the cases, while Thelazia gulosa only in 25%. Both species were observed together 20% of the time. The average number of nematodes observed per case was 6 with a range of 1 to 36.

This survey was begun in January, 1980 and will continue for the remainder of the year in order to make observation throughout all seasons.

11:30 a.m.
GENERAL DISCUSSION

12:00 a.m.
LUNCH

SUNDAY, JULY 20 - Sheraton Washington Hotel, Wisconsin Room
SECTION B: PARASITES OF RUMINANTS, SWINE & POULTRY
PRESIDING OFFICER: T.J. HAYES
1:00 p.m.

STATE OF THE ART IN NEMATODE VACCINES FOR RUMINANTS.

H. HERLICH, Science and Education Administration, Animal Parasitology Institute, Beltsville, Maryland.

The successful cultivation of a nematode from the infective larva through the mature adult in vitro (Weinstein and Jones, 1956) and the demonstration that infective larvae of the lungworm, Dictyocaulus viviparus, attenuated by X-ray irradiation could be used to vaccinate cattle (Jarrett et al. 1958) appeared to usher in a new era for control of nematode parasites by vaccination. Although there has subsequently been much research involving these two methodological approaches to immunization using small animal-nematode model systems, disappointingly few investigations have involved ruminants and their nematode parasites. A resume of the latter studies and conclusions about the state of the art of nematode vaccines for ruminants will be presented.

1:20 p.m.

RESPONSE OF LAMBS TO VACCINATION WITH TRICHOSTRONGYLUS COLUBRIFORMIS: SEGREGATION INTO "RESPONDERS" AND "NON-RESPONDERS" AND HERITABILITY OF RESISTANCE.

J.K. DINEEN, CSIRO McMaster Laboratory, Syndey, Australia.

Random bred Merino rams and live lambs were vaccinated at 1, 2, and/or 3 months of age with γ-radiation attenuated 3rd stage larvae. An exponentially increasing challenge of normal larvae designed to simulate natural field infection was given to all groups including a group of unvaccinated control lambs. Challenge was commenced at 2 month of age. The results, based on faecal egg counts, showed dissociation into lambs responding to vaccination and those which failed to respond. The proportion of responders was greatest in groups vaccinated at the earliest age (1 month).

This study and previous work on age-dependent responsiveness to vaccination shows that about 50 percent of lambs are "responders" at weaning and the performance of the F1-progeny of assortative "responder" and "non-responder" matings has shown that this bimodal distribution of responsiveness is genetically determined. The estimate of heritability (h^2) based on half-sib correlation is 0.7 to 0.8. Within "responder" and "non-responder" matings, ewe lambs responded more vigorously than ram (or wether) lambs.

Currently, "responder"/"non-responder" correlates are being sought within the major histocompatability complex for use as genetic markers.

1:40 p.m.

IMMUNOLOGICAL APPROACHES TO HELMINTH CONTROL IN SWINE: A REVIEW.

K. D. MURRELL, Science and Education Administration, Animal Parasitology Institute, Beltsville, Maryland.

Vaccination strategies for the control of swine helminths include: (1) prevention of parasite entry into the host; (2) inhibition of larval migration and development, particularly in the tissues; and (3) expulsion of worms from the intestines. The relative merits of these approaches for Ascaris suum, Stephanurus dentatus and Strongyloides ransomi will be discussed, including their possible dependence on stage-specific antigens and/or protective immune mechanisms. Progress in vaccine development will be reviewed and promising areas for future research indicated.

2:00 p.m.

COCCIDIOSIS IN PIGLETS.

B. P. STEWART, Veterinary Diagnostic and Investigational Laboratory, University of Georgia, Tifton, Georgia.

Interest is increasing in clinical coccidiosis in piglets in swine raising areas of the United States. In south Georgia the species responsible for the scours, dehydration, weight loss, and death in 5-10 day old piglets is Isospora suis.

Inoculation of 150,000 to 400,000 sporulated oocysts of I. suis into 1-3 day old piglets resulted in disease identical to that seen in spontaneously occurring clinical outbreaks. Gross lesions were seen in approximately 20% of the experimental cases (dosed with 200,000 sporulated oocysts of I. suis) and "field" cases, and was characterized by presence of a fibrinonecrotic membrane in the jejunum and ileum. Microscopically, variable mild to severe villus atrophy with or without the presence of an adhered necrotic membrane was present. The greatest tissue destruction was associated with massive asexual division at 96 hours post inoculation. Asexual stages consisted of two distinct meronts and merozoites (type I and II). Oocyst passage begins at 5 days post inoculation and lasts for 5-8 days. The source of infection to the piglet remains somewhat of a mystery because of the low oocyst passage by the sows in the presence of clinical outbreaks in the piglets. Amprolium therapy has been beneficial in preventing the disease but treatment of scouring piglets with amprolium has minimal efficacy. Detailed characterization of the life-cycle and endogenous stages of I. suis and the immune resistance factors in older swine need to be studied.

2:20 p.m.

UPDATE ON 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 2-4 cc for a 100 lb animal followed by 2 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 lbs 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 3 days. Cadmium salts were more palatable, not as acutely toxic as sodium fluoride and could be fed in wet feeds. They cound 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 at 5 days of age and repeat treatment at 10 days of age.

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.

Swine parasites may be controlled by producers following a schedule of anthelmintic treatments. Gilts and sows are treated with a broad spectrum anthelmintic 5 to 10 days before breeding and again 5 to 10 days before farrowing. This removes the parasites from the dam's digestive tract which serve as a source of infection in the farrowing house. If kidney worms are a problem, the gilts and sows should be treated with levamisole.

The pigs should be treated with an anthelmintic when they are 5 to 6 weeks of age and again 30 days later.

UPDATE ON SWINE ANTHELMINTICS (continued)

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

3:00 p.m. BREAK

3:15 p.m.

SARCOCYSTIS - INFECTIONS AMONG WILD AND DOMESTIC SWINE.

A.K. PRESTWOOD, H.T. McDANIEL, and R.W. CAHOON, College of Veterinary Medicine, University of Georgia, Athens, Georgia.

Digestion techniques revealed 16.6% of mature Georgia sows and 32.1% of wild swine from six southeastern states to harbor zoites of Sarcocystis spp. Overall prevalence of infection was similar in domestic swine originating in north and south Georgia but varied widely among wild swine. Wild swine harboring Sarcocystis-infections were found mainly in the mountainous region of the Southeast or in swine translocated from that area.

Laboratory-reared dogs, cats, raccoons (Procyon lotor), and opossums (Didelphis marsupialis) were fed pooled samples of infected meat. Sporocysts (8.3 um x 11.2 µm) were shed in feces of dogs and raccoons. Sporocysts from dogs were used to infect Sarcocystis-free domestic pigs. Two months later these swine were euthanatized and meat fed to dogs and raccoons. Both species shed sporocysts after ingestion of meat infected with sporocysts of swine-dog origin. This is the first occasion in which a definitive host has been demonstrated for a species of Sarcocystis occurring in North American swine. The raccoon constitutes a new host for S. suicanis, Erber, 1977.

3:30 p.m.

DIFFERENTIATION OF LATE FOURTH AND EARLY FIFTH STAGES OF ASCARIS SUUM GOEZE, 1782 (NEMATODA: ASCARIDOIDEA) IN SWINE.

P. A. PILITT, J. R. LICHTENFELS, F. G. TROMBA and P. A. MADDEN, Science and Education Administration, Animal Parasitology Institute, Beltsville, Maryland.

Late fourth-stage larvae and early fifth stages of Ascaris suum were studied to determine reliable anatomical characters for differentiating stages of development. Late fourth and early fifth stages had overlapping body lengths: late fourth-stage larvae at 21, 23, and 24 DAI ranged from 13 to 27 mm in length; a single female in fourth ecdysis was 27 mm long at 24 DAI; and, early fifth stages at 23 and 24 DAI were 22 to 36 mm long. Late fourth-stage larvae have dome-shaped lips that are broadest at the base and are incompletely separated laterally. The lips bear coarse, triangular-shaped denticles irregularly spaced on the internomedial and internolateral walls. Large double papillae are located on the middle of the external lip surface. The external lip surfaces are rounded in the overall view. Early fifth-stage lips are truncate, broadest at the level of the prominent double papillae, are constricted slightly at the base and are widely separated laterally. The lips bear fine, regularly spaced denticles on the internal margins. The prominent double papillae are located slightly anterior to the middle of the external lip surface. The external lip surfaces are flat in overall view. In late fourth-stage larvae the cervical region gradually increases in width posterior to lips. In early fifth stages the cervical region sharply increases in width posterior to lips giving a shouldered appearance. The late fourth-stage cuticle is marked by a coarse transverse striation, annules are wide (0.017-0.029 mm) and bear incomplete longitudinal ridges that create a brickwork pattern and longitudinal alae are present. The early fifth-stage cuticle is finely striated, annules are narrow (0.002-0.003 mm) without markings and longitudinal alae are absent.

3:45 p.m.

INHIBITION OF DEVELOPMENT OF ASCARIS SUUM LARVAE IN VITRO BY SWINE ALVEOLAR MACROPHAGES.

JOSEPH F. URBAN, JR. and F.G. TROMBA, Science and Education Administration, Animal Parasitology Institute, Beltsville, Maryland.

An in vitro system was established for analysis of the effect of lymph node (LN) cells and alveolar macrophages (Mac∅) from swine vaccinated against Ascaris suum on the development of second stage larvae. Purebred Hampshire pigs were vaccinated per os with five successive doses of 10,000 U.V. irradiated A. suum eggs. Eight vaccinated and seven untreated pigs were challenged per os with 10,000 embryonated eggs and necropsies performed 7 days later. Recoveries of larvae from the lungs averaged 11.3 ± 17.3 for vaccinated pigs and 160 ± 122 for the controls. Lymph node cells were obtained at necropsy, and alveolar Mac∅ were isolated from a cell suspension obtained by lung lavage after incubation in tissue culture wells containing Dulbecco's MEM media supplemented with 10% heat inactivated bovine serum for 4-12 hr, followed by vigorous washing to remove non-adherent cells. Larvae were hatched from embryonated eggs and placed in culture wells containing: 1) medium alone, 2) LN cells, 3) Mac∅ monolayers, and 4) LN cells plus Mac∅. Cultures were maintained for 9-14 days followed by examination of larvae for development. It was observed that in cultures of LN cells from vaccinated and control animals approximately 39% of the larvae had developed to third stage. In comparison, 51% of the larvae from cultures containing media alone were third stage. A marked inhibition of larval development was observed in cultures containing Mac∅ from either vaccinated or control animals, 18% and 14%, respectively. The effect was only marginally increased when larvae were exposed to both LN cells and Mac∅. The results indicate that Mac∅ can express an activity in vitro which is inhibitory to larval development, but the experimental system, as presently constructed, is not sensitive enough to distinguish immunological differences between vaccinated and control animals following challenge.

4:00 p.m.

EFFECT OF COCCIDIOSIS ON ORGAN AND TISSUE COMPOSITION IN CHICKENS.

M. D. RUFF, P. C. ALLEN and M. B. CHUTE, Science and Education Administration, Animal Parasitology Institute, Beltsville, Maryland.

Infection with Eimeria acervulina, Eimeria brunetti, or Eimeria tenella affected the composition of the breast, thigh, heart and liver of 3- or 4-week old broiler chickens. Liver glycogen was significantly increased at 6 and 8 day post-inoculation (PI) with E. acervulina. Conversely, liver glycogens were decreased at 4 and 6 days PI with E. tenella and were unaffected by E. brunetti. The level of RNA and lipid in the liver was decreased with E. acervulina infection but unchanged with E. tenella infection. Both species decreased RNA levels in the breast. None of the three coccidia species studied had any effect on moisture, ash, protein, or DNA content of the tissues.

4:15 p.m.

EFFECT OF EIMERIA ADENOEIDES INFECTION ON HEART COMPOSITION AND FUNCTION IN TURKEYS.

P. C. AUGUSTINE, Science and Education Administration, Animal Parasitology Institute, Beltsville, Maryland.

Eimeria adenoeides infection in young turkeys affects both the composition and function of the heart. In turkeys inoculated with 3×10^4 sporulated oocysts, hearts (as % of body weight) were significantly smaller from days 6 to 10 post-inoculation (PI), but returned to normal size by day 15 PI. Heart weights (% of body weight) were not reduced in uninoculated pair-fed turkeys. The heart moisture of the infected turkeys did not change although the birds appeared to be dehydrated. However, the lipid content was reduced by 25 to 27% on day 6 PI and 40% on day 7 PI.

On day 5 PI, body temperatures and heart rates of infected and control turkeys were similar. However, on day 6 PI, the mean heart rate of the infected birds was 336 beats per minute (PBM) as compared with 388 BPM for the controls. Body temperatures of the 2 groups were similar. The duration of the RS complex of infected turkeys was similar to that of the controls, but the voltage of the complex was reduced by $\sim$33%. One of the most usual causes of decreased QRS voltage in mammalian systems is diminished muscle mass. It appears that reduced RS complex voltage in turkeys is also associated with reduced heart muscle mass.

4:30 p.m.

EFFECTS OF ARPRINOCID ON DEVELOPMENTAL STAGES OF EIMERIA TENELLA.

E. C. McMANUS, G. OLSON and J. D. PULLIAM, Merck Sharp and Dohme Research Laboratories, Rahway, New Jersey.

Restricted medication experiments were done to correlate time of arprinocid medication with developmental stages of the life cycle of Eimeria tenella. By the criterion of histopathology and using a massive inoculum (10^6 sporulated oocysts), 50 ppm was partially active and 70 ppm was fully active against the first asexual generation when medication was delayed to day 1. When medication was delayed to day 2, full activity was demonstrated against the late first asexual generation. When medication was delayed to day 3, definite but less complete activity was shown against the late second asexual generation. Using the conventional efficacy parameters and with an inoculum of 5×10^4, full activity occurred with 50 ppm when medication was started up to day 2. Essentially full activity was observed with 60 ppm started at day 3. The combined results of the two tests are interpreted to indicate high activity against both the first and second asexual generations. Medication with 70 ppm changed the wall-forming bodies of the macrogamete. They were indistinct and less intensely eosinophilic than controls.

4:45 p.m.
GENERAL DISCUSSION

5:00 p.m.
BUSINESS MEETING, COLORADO ROOM

6:00 p.m.
HOSPITALITY HOUR, PRESIDENT'S ROOM

MONDAY, JULY 21 - Shoreham Hotel, Executive Room
DEWORMING OF DAIRY CATTLE
PRESIDING OFFICER: J.F. WILLIAMS
8:00 a.m.

ON THE PREVALENCE, NATURE AND ECONOMIC IMPACT OF DAIRY PARASITISMS IN WISCONSIN.

A. C. TODD, V. C. GUTIERRES, G. H. MYERS, II, D. BLISS, J. CROWLEY, JR., L. GRISI, and G. H. MYERS, III, Department of Veterinary Science, University of Wisconsin, Madison, Wisconsin.

A summary of the genera of nematodes and the numbers of worms found in 100 cull dairy cows, mainly from Wisconsin but also from other states, will be presented. Eighty-nine of the 100 cows (89%) had worms; the numbers ranged from as few as 5 to 24,415. The largest number of worms was found in the oldest cow in the survey. When numbers of worms recovered were arrayed against ages of the cows, there was no evidence of increasing age resistance and certainly no evidence of immunity.

A comparison will be given of egg-count techniques to diagnose nematode parasitism.

A summary of milk production increases obtained after deworming trials with more than 3,500 cows will be given. Cows in 3 of 4 herds responded by producing more milk, in amounts ranging from 2.2 lb./day in midlactation, to as much as 1,075 lb. lactation when cows were dewormed at freshening.

A direct, effective field trial to obtain conclusive data for the veterinarian in practice will be presented.

A review and discussion of data obtained from treatment of replacement heifers will be given.

9:00 a.m.

EFFECTS OF THIABENDAZOLE TREATMENT OF LACTATING DAIRY COWS IN MAINE.

H. C. GIBBS, Department of Animal and Veterinary Sciences, University of Maine, Orono, Maine.

An experiment was conducted to evaluate the effects of anthelmintic treatment, at freshening, on the milk production of dairy cows. Two hundred and twelve animals (106 control and 106 treated) from seven herds on the DHIA program were used. Animals in each herd were paired, as closely as possible, according to age, date of freshening and previous lactation performance. One animal in each pair was randomly assigned to treatment with T.B.Z. boluses (100 mg/kg) on the day of freshening, the other animal served as an untreated control. Fecal samples were taken from both animals on the day of freshening and six days after treatment. DHIA milk records for 305 day lactation were used and converted to mature equivalents for comparison. All animals were positive on fecal examination before treatment for nematode eggs. Following treatment fecal counts became negative.

Analysis of the milk production data showed no statistically significant differences between the treated and untreated animals with a 407 lb difference in favor of the untreated animals.

9:15 a.m.

THE EFFECT OF THIABENDAZOLE TREATMENT ON DAIRY COWS IN OHIO

L.E. HEIDER, C.H. COURTNEY, and R.P. HERD, College of Veterinary Medicine, The Ohio State University, Columbus, Ohio.

The effect of anthelmintic treatment at calving on dairy cows at pasture was evaluated. A total of 112 cows were paired by parity and month of calving. One animal in each pair was randomly selected for treatment with TBZ boluses (66-100 mg/kg) on the day of calving. Mature equivalent production records were used to analyze production levels, changes and differences. Total worm counts were done on 30 cows, 6 of which were treated cows and 9 of which were control cows. Fecal samples were collected from all cows in the month prior to calving, on the day of calving, and in the month following calving. Plasma pepsinogen levels were determined both before and after calving.

Production was not significantly different between groups in the lactation period preceding the trial nor in the lactation period during the trial. Cows in both groups produced significantly more milk in the lactation during the trial period than in the previous lactation. The increase was greater in the treated cows (287 lbs.) but was not statistically significant. Treated first lactation heifers (n=14) produced 36 lbs. more milk per lactation than untreated cows. This difference was not significant.

Mean total worm count for 6 treated cows slaughtered at 5-9 months following treatment was 1258. Mean total worm count for 9 untreated cows was 3805. The difference was significant ($p < .05$). Ostertagia ostertagi was the predominant parasite. Mean fecal egg counts remained low (<12 epg) even during the periparturient period in both treated and control cows. There was no significant difference between groups. Plasma pepsinogen levels also remained low with no significant difference between treated (1727 mu) and control (1692 mu) groups.

9:30 a.m.

EFFECT OF THIABENDAZOLE TREATMENT ON DAIRY COWS IN TEXAS.

R. R. BELL, College of Veterinary Medicine, Texas A & M University, College Station, Texas.

Preliminary results from four herds in Northeast Texas show that treatment of dairy cows at termination of lactation and two weeks before calving using a paste formulation of thiabendazole show a slight increase in milk production in three herds and a reduction of milk production in the fourth herd.

On the basis of these preliminary results in a small number of cattle there was no advantage in treating the dairy cows with this anthelmintic.

9:45 a.m.

EXPERIENCES WITH COUMAPHOS TREATMENT OF FRESHENING DAIRY COWS IN CALIFORNIA.

J. E. MILLER and N. F. BAKER, School of Veterinary Medicine, University of California, Davis, California.

Previous studies on a closed California drylot dairy indicated that coumaphos treatment of freshening cows was ineffective in increasing milk production. Fecal egg counts on that dairy showed that parasitism was not a problem, in that over 90% of the herd had zero counts. To carry the investigation further, four predominantly pasture dairies are now under study where "subclinical" parasitism, as determined by fecal examination, does exist.

In order to evaluate the administration and effectiveness of the coumaphos treatment, dairymen were given a list of the cows to treat and how much to give them. Two problems immediately surfaced regarding the administration of the anthelmintic. First, the type of milking barn dictates how accessable the feeders are to the person doing the treating. Herringbone parlors where the feeder is not readily accessable during milking has, among several problems, required that the milker leave the milking station to administer the coumaphos. Flat barn feeders usually require someone to move back and forth in front of the cows, thus causing minor disturbances. Side opening parlors appear to be the best for ease of administration as the feeders are readily accessable without disturbing the cows. Second, automatic feeders can dilute out and/or cover up the coumaphos crumbles, thus creating the possibility of inadequate anthelmintic intake.

A twelve-month trial on one dairy indicates that coumaphos treatment has been ineffective in reducing egg counts in fecal analyses. Milk production data for the first 90 days of lactation of cows freshening in all 12 months show no difference between untreated and treated cows.

10:00 a.m.

BREAK

):15 a.m.

MILK PRODUCTION OF GRAZING DAIRY COWS AFTER TREATMENT WITH FENBENDAZOLE.

. A. BARGER, CSIRO Division of Animal Health, Armidale N.S.W., Australia.

The Australian dairy industry is based on year-round grazing of grass and legume pastures, and cows are continually exposed to infection with helminth parasites. It has long been recognized that these infections may cause disease or reduced growth rates in calves and replacement heifers, but little is known of the effects of nematode parasites on the productivity of adult dairy cows.

Two recent studies, stimulated by U.S. reports of increased milk production following anthelmintic treatment, have not shown any effect of anthelmintic treatment on milk yields of grazing dairy cows. In the first study (Aust. Vet. J. 55:68), 171 cows in 10 herds were given a single treatment with 7.5 mg/kg fenbendazole and their milk production compared over the following 2 months with that of 164 untreated cows in the same herds. In the second study, which is still in progress, the milk production of cows treated with fenbendazole at monthly intervals is being compared with that of untreated cows in the same herds in sub-tropical and temperate environments. Preliminary results of this experiment indicate that milk production has not been increased by monthly treatment throughout lactation. Both studies have confirmed that most cows are infected, although faecal egg counts are invariably low (3 e.p.g.).

These results demonstrate that anthelmintic treatments may not increase milk production when cows are constantly exposed to reinfection. It is possible that the worm burdens carried by most adult cattle are too small to be pathogenic. An alternative hypothesis is that a continual larval challenge to adult cattle can negate any benefits of anthelmintic treatment.

10:30 a.m.

VARIATIONS IN PRODUCTION RESPONSE AFTER ANTHELMINTIC TREATMENT LEADING TO A NEW CONCEPT IN WORM CONTROL IN DAIRY CATTLE.

R. M. JONES and D. H. BLISS, Pfizer Central Research, Pfizer Limited, Sandwich, Kent. U.K.

The persistence of gastro-intestinal parasitic infections contaminating the environment of grazing cattle is not altered by conventional anthelmintic treatment. Re-exposure to infection begins immediately after drug elimination if the cattle remain in the previously contaminated environment after treatment. The economic impact of subsequent parasite acquisition following treatment is seldom accounted for in production studies whether the host is susceptible or immune. The present series of studies involves the development of a sustained anthelmintic delivery system designed to remove and prevent re-establishment of parasite infections over extended periods of time.

This paper reports the results of trials to assess the efficacy of the delivery system, the morantel (13.5 g.) Sustained Release Device (MSRD), to control parasitism under natural field conditions in first and second-season grazing calves. Administration of the MSRD at the time calves were turned out onto spring pasture (early-season use) was compared with administration mid-way through the grazing period to coincide with the beginning of the normal mid-summer rise in pasture larval contamination (mid-season use). Further comparisons were made on the effect of treatment upon egg deposition and the levels of infective parasite larvae on each treatment pasture (determined by larval counts on herbage) and upon the subsequent differences in the growth patterns of the calves grazing each pasture.

A total of 211 first-season grazing calves received the MSRD in early-season in twelve field trials in seven European countries. Substantial reductions in pasture contamination and faecal egg counts and significant improvement in weight gains were recorded when compared with control animals grazing divided pasture. Treated calves outperformed control calves which received conventional anthelmintic therapy by an average of 46.5 lbs. (21.1 kg.) by the end of the grazing season. In ten of the twelve trials, 168 mid-season MSRD treated calves were compared directly with an equivalent number of early-season treated animals. Although faecal egg counts were reduced after mid-season treatment, pasture contamination levels were not significantly affected and hence performance responses were less favorable. Average weight gain was 37.7 lbs. (17.1 kg.) less than that of the early-season treated calves. Four other trials with a total of 208 second-season grazing cattle resulted in a mean weight gain advantage of 35.3 lb. (16.0 kg.) in early-season MSRD treated animals compared with negative controls.

Labour costs (for treatment and handling) were minimized in the early MSRD treated calves compared with conventional therapy.

10:45 a.m.

A SIMPLE CONTROL PROGRAM FOR PARASITISM IN DAIRY REPLACEMENT HEIFERS IN OHIO.

R. P. HERD and L. E. HEIDER, College of Veterinary Medicine, The Ohio State University, Columbus, Ohio.

A prophylactic control program for dairy replacement heifers during their first grazing season was evaluated. This program was based on the administration of 2 anthelmantic treatments 3 and 6 weeks after heifers were first turned out to spring pastures. It was anticipated that most overwintered L3 on pasture would have died out by the time of the second treatment. Eleven dairy replacement heifers (mean body weight, 262.0 kg) were given 2 such treatments after they were moved from confinement to permanent pastures in May, 1979 and compared with 11 control heifers (mean body weight 262.4 kg) grazing separate, but identical pastures.

Treated heifers gained significantly ($p<0.01$) more weight than the control heifers and outweighed them by mean values of 9.2, 19.7, 31.0, and 39.5 kg at the end of July, August, September, and October, respectively. Control heifers had highest egg counts (47-51 epg) from July to September, but there was a 2-month delay before treated heifers attained peak concentrations (42 epg). This delay occurred at a critical time of the year (July, August) when environmental conditions were favorable for the rapid development of eggs to infective larvae. When the egg count for treated heifers peaked at the end of September, environmental conditions were no longer favorable for optimal development of free-living stages.

The results demonstrate the value of prophylactic anthelmintic treatments for dairy heifers during their first year of grazing. The results also suggest that 2 strategic dosings in the spring can protect heifers against internal parasitism for the entire grazing season and result in an 82.5% increase in weight gain at the end of October, without apparent need for further treatment in the summer or fall. This program is economical and feasible and the administration of only 2 treatments per year is unlikely to result in strong selection pressure for worm resistance to anthelmintics.

11:00 a.m.

CONTROL OF PARASITISM IN DAIRY CATTLE IN BRITAIN AND EUROPE.

J. ARMOUR, Faculty of Veterinary Medicine, Glasgow University, Glasgow, Scotland.

In Western Europe, clinical parasitism in adult dairy cattle is comparatively rare though outbreaks of ostertagiasis and dictyocauliasis do occur in this age group. However, there is increasing interest in the effect of low burdens of gastrointestinal nematodes (so called sub-clinical parasitism) on milk production as several surveys have shown that low burdens, particularly of Ostertagia spp., are frequently present. As a result of these surveys, the use of an anthelmintic treatment at the time of calving is increasing and several trials to evaluate the economic benefits of such treatments have been completed in various countries; the results of these will be summarized. In most instances there was a trend towards increased milk production in the treated cows compared with untreated controls or with previous lactations. However, because of the marked variation between yields these positive differences were often not statistically significant.

There is also considerable interest in the mechanism by which these comparatively low worm burdens can affect production and the possibility exists that there is an immunological basis for the lesions which result following re-infection of an adult cow. Some preliminary data from studies on re-infection of cows will be presented.

11:45 a.m.
GENERAL DISCUSSION

12:00 a.m.
LUNCH

MONDAY, JULY 21 - Shoreham Hotel, Executive Room
EPIDEMIOLOGY AND CONTROL OF RUMINANT PARASITES
PRESIDING OFFICER: R. P. HERD
1:00 p.m.

AN EPIDEMIOLOGICAL APPROACH TO PARASITE CONTROL IN CATTLE AND SHEEP

J. ARMOUR, Faculty of Veterinary Medicine, Glasgow University, Glasgow, Scotland.

Epidemiological studies in many parts of the world have established that the populations of infective stages of the parasitic helminths of cattle and sheep fluctuate seasonally with clearly defined alternating periods of maximum and minimum availability. It has also been shown that these phases of maximum availability are derived from contamination of the environment during limited periods when the climate is particularly suitable for development of the contaminating stage to the infective stage.

Control methods based on either a) avoidance of grazing areas during maximum larval availability, or b) using anthelmintics to prevent contamination during optimal times for development to the infective stage, have proved particularly successful and are likely in certain instances to be more widely used in future. A combined use of the above strategies with alternation of both host species or integration of "immune" adult stock with the susceptible young have also proved beneficial; however, in the former, cross infection of the alternate hosts occurs with some helminth species and has limited the use of alternate grazing in many countries. In the latter, production problems associated with a larval challenge on "immune" adults may restrict the use of integrated rotational systems.

All control measures exert a selection pressure and there is some evidence that despite the sound epidemiological basis for these systems that strains of helminths are emerging with a differing epidemiology and pathogenicity.

2:00 p.m.

CONTROL OF CATTLE AND SHEEP HELMINTHS BY GRAZING MANAGEMENT.

I. A. BARGER, CSIRO Division of Animal Health, Armidale, N.S.W., Australia.

Attempts to control helminth parasites by grazing systems involving short-term pasture rotations have been generally unsuccessful, because of the prolonged survival on pasture of the free-living stages of these parasites. In the last decade, however, relatively simple management procedures based on knowledge of the epidemiology of parasitic diseases, have been developed to the state where they offer levels of control equivalent to those obtained by intensive anthelmintic treatment. One attribute shared by these systems is the concept of the safe pasture, which may be described as a pasture carrying such low levels of contamination with eggs and larvae that it may safely be grazed by susceptible animals. Methods used to produce safe pastures vary with climate, species of parasite, and the animal production system being protected, but all have as their aim the avoidance of contamination at critical times in the epidemiology of the economically important parasitic diseases. Methods commonly used include avoidance of grazing, alternate grazing with different host species such as sheep and cattle, grazing with resistant animals of the same species, and strategic anthelmintic treatments. The timing of these procedures is often critical, and should be determined in the light of a broad knowledge of the epidemiology of the helminth disease and its interactions with the animal production system in each environment.

2:15 p.m.

EPIDEMIOLOGY OF OSTERTAGIASIS AND SOME OTHER NEMATODE PARASITES OF CATTLE IN CALIFORNIA.

N. F. BAKER, School of Veterinary Medicine, University of California, Davis, California.

Studies utilizing worm-free tracer calves to assess seasonal levels of "normal" and "hypobiotic" infective larvae of cattle nematodes on irrigated pastures have been continued. Data has been obtained from a ranch near Sierraville, a ranch near Susanville, and at the University of California Sierra Foothill Range Field Station near Marysville, California.

As regards safe and unsafe grazing periods, data indicate safe periods are confined within the overall period of May to December while unsafe periods are between the months of January and May. As regards the occurrence of hypobiosis, data shows this to be maximized during the same period that the maximum number of larvae are developing directly to adult parasites. This chronology suggests that ostertagiasis, which commonly occurs in the spring, is largely of the Type I form, while that which occurs in the fall and early winter is largely of the Type II form. Infection levels with Cooperia sp. were analagous to those of Ostertagia ostertagi, however, significant numbers of hypobiotic forms of Cooperia sp. did not occur.

Of particular interest is the continuing observations showing essentially no infection during summer months. This data is in agreement with data obtained at Elk Grove in 1976. Should this finding be firmly established, and there is every reason to believe it will be, previous concepts of parasite control on irrigated pasture during summer months in California will be greatly modified.

2:30 p.m.

EPIDEMIOLOGIC ASPECTS OF TRANSMISSION OF RUMINANT HELMINTHS IN TEXAS.

T. M. CRAIG, College of Veterinary Medicine, Texas A & M University, College Station, Texas.

In a state with as diverse climatic conditions as Texas where the average annual precipitation varies from nearly 1250 mm in the far eastern swamps and forests to 225 mm in the desert far west the epidemiological aspects of parasite transmission are many and varied. Four species of ruminants must be considered when the transmission of helminths is studied, cattle, sheep, goats and deer are found in varying combinations throughout the state and may serve to augment or interfere with the transmission of various helminths. During most years parasitic problems are encountered in sheep and goats in the Edwards Plateau where Haemonchus is the primary parasite during the warm seasons and where spring and summer rains give rise to large parasite numbers which mostly affects grazing sheep whereas browsing goats may escape devastating disease.

In general, cattle parasites in Texas can be divided into cool season and warm season species. This parasite transmission can be, to a large extent, correlated with the availability of the warm or cool season forages which are cultivated in the state. Depending upon locality, warm season grasses and parasites will begin to appear from mid March and last until the first part of November. The major genera of parasites that will be transmitted during this period of time are Haemonchus, Cooperia, Bunostomum and Dictyocaulus. Weather conditions, stocking rates, class of cattle, (i.e., dairy calves vs. mixed aged beef cattle) will largely determine if sufficient transmission occurs to be associated with helminthosis. The cool season parasites Ostertagia, Fasciola and Fascioloides are transmitted largely between late September and early May. The impetus for transmission seems to be associated with the autumn rains which may begin as early as September. This cool season is the activity period for lymnaid snails which are not active during the hot, generally dry, summers.

Arrested development of Ostertagia is first seen in November and December, however, the largest percentage of larvae undergoing arrested development are picked up in March and April with virtually no transmission occurring after the 1st of May. There is some evidence that this arrested development is stimulated by cooling but allows for survival of the parasite during the hot, dry summers.

2:45 p.m.

EPIDEMIOLOGY OF OSTERTAGIASIS IN CATTLE IN LOUISIANA.

J. C. WILLIAMS, Department of Veterinary Science, Louisiana State University, Baton Rouge, Louisiana.

Studies on the epidemiology of ostertagiasis of beef cattle in Louisiana have been carried on over the last 3 years at sites in the north and south of the state. Major objectives of this study have been to determine the time period during which larval inhibition occurs, and whether or not the clinical disease types, as described in Europe and elsewhere, might be substantiated and defined under climatic and management conditions in Louisiana. Through most of each of the last 3 years, naturally infected yearlings have been slaughtered monthly to determine characteristics of populations of O. ostertagi and other nematode genera. Although low levels of larval inhibition occur from December through February, peak levels are observed from March through May. Studies with tracer calves grazed for brief intervals have substantiated this; few inhibition-prone larvae are acquired prior to March and after peak levels during March through May, acquisition declines in June. Large populations of inhibited Ostertagia have persisted in yearling cattle and tracer calves through August. Evidence to the present indicates that infection with Ostertagia is minimal during the hot summer and few adult worms are found in cattle at this time. However, beginning in August, infection level increases, coincident with a decline in numbers of inhibited larvae. Cattle infected with large accumulations of inhibited larvae in the spring (April) have been treated with the new benzimidazole anthelmintics. High levels of efficacy were observed, but some variability of efficacy has also been encountered. Results to the present suggest a climatic induction of larval inhibition (spring) from which manifestations of type II infection might occur from late spring to autumn, but particularly in late summer to early autumn. Infection or disease outbreaks resulting from larvae acquired during autumn through winter can be presumably classified as type I.

3:00 p.m.

EPIDEMIOLOGY OF GASTROINTESTINAL HELMINTHIASIS IN MAINE DAIRY CATTLE.

H. C. GIBBS, Department of Animal and Veterinary Sciences, University of Maine, Orono, Maine.

Nematode ova count and larvae identification studies have shown that there is a high incidence of gastrointestinal helminthiasis in Maine dairy cattle. Some 96% of cows, 99% of heifers and 97% of calves were found to be passing ova of the strongyle genera Ostertagia, Cooperia, Trichostrongylus, Haemonchus and Oesophagostomum. Worm ova production was highest in calves followed by heifers and cows. There was marked variation in strongyle ova production related to season. Peak production occurred in May and June after which counts steadily decreased to their lowest levels in January and February. Examination of gastrointestinal tracts from yearling animals has substantiated these findings. A definite, seasonally-related, distribution pattern was observed in the strongyle genera present in these animals. Mainly adult worms were present in animals during the spring and early summer months which coincided with the period of greatest ova production in the previous study. While highest numbers of worms were recovered during the fall and early winter months, these were mainly immature worms.

Seasonally-related variation in developmental patterns was also observed in pasture plot studies. Levels of infection in susceptible calves exposed to contaminated pasture gradually increased with highest ova production occurring approximately eight weeks after infections became patent. Following this was a sharp decline in counts to very low levels in the fall. This was apparently due to the development of immunity and a subsequent self-cure of mature worms.

Susceptible calves acquire infection by way of infected carrier calves in addition to overwintered larvae on pasture. Assessment of the relative importance of these two sources of infection has shown that the overwintered larvae, at least in the short run, are most important. Overwintered larvae decrease in numbers on pasture as the following grazing season progresses but can persist, at clinically significant levels, until mid-summer.

3:15 p.m.

PERIPARTURIENT RISE IN NEMATODE EGG OUTPUT BY MATURE BEEF COWS IN VIRGINIA.

B. HAMMERBERG, College of Veterinary Medicine, Virginia Polytechnic Institute and State University, Blacksburg, Virginia.

The level of strongylid egg output by mature beef cows with subclinical parasitism was monitored to determine whether or not a periparturient rise in fecal egg counts occurred in spring-calving cows grazed on hillside pastures in southwest Virginia. Eighty-five, 5-year-old bred cows were removed from pasture in the late fall and placed in drylots after anthelmintic treatment. Forty-one Angus and 44 Angus-Holstein cows were randomly divided into two groups receiving 80% and 100% of NRC recommended TDN during winter housing. Changes in fecal nematode egg counts for individual cows, quantitated by the Wisconsin sugar flotation technique, were detected perinatally and correlated with breed, nutritional level, and time of the year. These cows had a significant rise in egg counts at the time of calving. This rise did not appear to result from infective larvae potentially available during spring-calving-months because cows wormed at the time of calving did not re-establish high egg counts. Statistical analysis of egg counts from the four breed-nutritional groups demonstrated that Angus-Holstein cows fed 80% TDN had the largest rise in egg output at parturition while this same breed fed 100% TDN had the smallest rise. Angus cows fed 80% and 100% TDN produced periparturient egg counts intermediate to the Angus-Holstein values. Although fecal culture for larval identification was not done on periparturient samples, subsequent fecal samples taken during fall grazing produced 50% to 60% Ostertagia larvae, 40-30% Cooperia larvae and less than 10% Haemonchus and Trichostrongylus larvae. These results are in agreement with published reports conducted with first lactation, dairy cows calving at various times of the year. Unpublished data from a dairy herd maintained in this region of Virginia also indicated the occurrence of periparturient egg rises. The magnitude of these perinatal changes in egg counts was greatest in first lactation cows.

3:30 p.m.

GENERAL DISCUSSION

3:45 p.m.

BREAK

MONDAY, JULY 21 - Shoreham Hotel, Executive Room
FASCIOLIASIS
PRESIDING OFFICER: R.E. BRADLEY
4:00 p.m.

EPIDEMIOLOGY OF FASCIOLA HEPATICA INFECTION IN DAIRY CATTLE AT DORADO, PUERTO RICO.

J. CHIRIBOGA, D. de LEON, and J. RODRIGUEZ-FRIAS, Agricultural Experiment Station, University of Puerto Rico, Rio Piedras, Puerto Rico.

Eighty-six percent (230 out of a total 268) of the cows in a Dorado dairy farm were found positive to F. hepatica on coprological examinaiton.

The highest infestation rate of 95.4% was determined in the older animals in the herd (9 to 12 yr. old), while the lowest rate of 71.3% was in the younger (3 to 3½ yr. old) animals.

L. cubensis, the predominant snail intermediate host for F. hepatica on this particular farm, is a relatively dynamic organism that has a potential life-cycle (egg to egg) of 21 days.

The number of snail habitats, the number of snails, and the percentage of F. hepatica-infested snails noticeably increased during the winter months of December, January and February, when there was high average monthly rainfall of 5.70 in. and low average monthly temperature of 24°C.

Cattle in the Dorado area acquire F. hepatica infestation only during certain months of the year, that is, from November to February. This finding disproves the assumption of year-around infestation.

An increase in the quantitative serum glutamic oxalacetic transaminase analysis (SGO-T) of cattle in an endemic area is important as it may indicate that the animals may have been exposed to F. hepatica infestation.

No effective control of fascioliasis in dairy cows in Dorado is recommended except sanitation and good nutrition.

4:15 p.m.

EPIDEMIOLOGY OF BOVINE FASCIOLIASIS IN LOUISIANA: SNAIL BIONOMICS AND SEASONAL TRANSMISSION

J. B. MALONE, A. LOYOCANO, K. C. CORKUM, M. LINDSAY and M. HUGH-JONES, School of Veterinary Medicine, Louisiana State University, Baton Rouge, Louisiana.

Ten-meter plots in 3 permanent Fossaria bulimoides habitats were monitored biweekly from November 1978 to December 1979 to correlate snail population dynamics to transmission of F. hepatica to resident cattle. Methods included: 1) collection of surface snails in a 1/10 m^2 quadrant, 2) a 15-minute visual search of the entire plot, and 3) water extraction of sub-surface snails from soil cores of 15 cm diameter and 10 cm depth. Lymnaeid snails found by each method at each site were enumerated (no/m^2), measured (up to 25), and screened for F. hepatica infection (up to 50). The seasonal availability of metacercariae was studied using 64 fluke-free sentinel steers consecutively placed (groups of 8) on pastures at 45-day intervals and by the prevalence of F. hepatica eggs found by fecal sedimentation of samples collected from 25 cows at quarterly intervals. An increase in snail numbers (150 to 1500 per square meter) was observed in March-May following a reproductive effort beginning in February. Snail numbers declined after the first draught in May and returned to numbers approximating that observed prior to the spring reproductive effort. F. hepatica infected snails were not found. Examination of livers of 64 sentinel calves at slaughter suggested that metacercariae of F. hepatica were available between May 24 and July 9 only. A total of nine flukes were found in 5 of 8 calves. Herd prevalence of F. hepatica eggs in feces rose from 6% in July to 40% in October. Results suggest that semi-annual treatment of cattle with anthelmintics affecting primarily adult flukes is most effectively given in the fall (Sept.-Nov.) and early spring (Feb.-March) in central Louisiana.

4:30 p.m.

ECONOMIC EFFECTS OF FASCIOLA HEPATICA IN CATTLE ON FEEDLOT RATIONS.

R. R. BELL, College of Veterinary Medicine, Texas A & M University, College Station, Texas.

Two groups of calves secured from fluke-free areas were divided and one-half of each group infected with F. hepatica and placed on feed for a period of 150 days. The animals were housed individually and feed-weighed daily. Considerable digestive problems developed in all groups, but there was no significant difference in weight gains or feed efficiency between the infected and non-infected groups.

A group of bulls naturally infected with F. hepatica were treated with albendazole when placed on an official gain test. A second group in the same test was left untreated. A weight gain advantage of 12.98% was observed for the treated group.

4:45 p.m.

RESPONSE OF LAMBS TO CHALLENGE INFECTIONS AFTER REPEATED INOCULATIONS WITH FASCIOLA HEPATICA CYSTS.

R. A. KNIGHT, Science and Education Administration, Animal Parasitology Institute, Beltsville, Maryland.

Four groups of lambs 8 months old were used in an experiment to study response of sheep to repeated infections with Fasciola hepatica. Groups 1, 2, and 3 were inoculated with 20 cysts each weekday for 5 weeks, and Group 4 was maintained as uninoculated controls. Group 3 was necropsied 13 weeks after the last inoculation, and Groups 1 and 2 were treated 2 weeks later with albendazole to terminate the infections. Group 1 was challenged with 500 cysts per lamb 4 days post-treatment, and Group 2 was challenged with 500 cysts per lamb 30 days post-treatment. Group 4 was inoculated with 500 cysts per lamb on the day that Group 1 was challenged. Groups 1, 2, and 4 were necropsied 14 weeks post-challenge. No significant differences in worm numbers were found between groups, though the challenged controls, of Group 4, had more worms. The only possible indication of acquired resistance was the presence of significantly smaller worms in the repeatedly infected lambs.

5:00 p.m.

DEVELOPMENT OF A CONTROLLED-RELEASED PROPHYLACTIC FASCIOLICIDE.

R. S. REW, Science and Education Administration, Animal Parasitology Institute, Beltsville, Maryland.

Usefulness of a fasciolicidal drug is limited if it is not effective early in the infection because it is the immature flukes that cause the majority of liver damage and deaths. Sheep or cattle on pasture may be constantly or intermittently exposed to infective cysts, thus for drug treatment to be maximally effective it should be present constantly. To achieve early, effective fascioliasis control, a controlled-release delivery system utilizing a drug effective against immature flukes may be a successful approach.

Albendazole has been released as an Investigational New Animal Drug by the Food & Drug Administration for limited use in the United States. Although albendazole appeared to have poor efficacy against immature flukes as a single dose, trials in our laboratory with repeated daily treatment of sheep prevented Fasciola hepatica infections. Sheep were inoculated on days 3-8 with 500 Fasciola hepatica cysts. Treatment was given as a premix at 1, 3, or 5 mg/kg/day from day 1 to 35. Necropsy of sheep at 14 weeks following cyst inoculation revealed 100% efficacy at 5 mg/kg/day, 98% efficacy at 3 mg/kg/day, and 42% efficacy at 1 mg/kg/day. Data from an additional study indicated that continual rumenal infusion of albendazole at 1, 3, or 5 mg/kg/day further supported these data. Treatment of sheep with a controlled-release product of albendazole may provide effective, prophylactic control of fascioliasis.

5:15 p.m.
GENERAL DISCUSSION