PROCEEDINGS

AAVP

AMERICAN ASSOCIATION OF VETERINARY PARASITOLOGISTS

43rd Annual Meeting
July 25-28, 1998
Baltimore, Maryland

and

MEMBERSHIP DIRECTORY

AMERICAN ASSOCIATION OF VETERINARY PARASITOLOGISTS
AWARDS HISTORY

Distinguished Veterinary Parasitologists

1985	J. P. Dubey
1986	N. D. Levine
1987	E. J. L. Soulsby
1988	J. F. Williams
1989	K. D. Murrell
1990	W. C. Campbell
1991	J. H. Drudge & E. T. Lyons
1992	G. F. Otto
1993	T. R. Klei
1994	P. M. Schantz
1995	J. C. Williams
1996	T.B. Stewart
1997	J. E. Williams

Hoechst-Roussel Agri-Vet Company Graduate Student Research Award

1987	L. G. Rickard
1988	D. A. Cross
1989	S. C. Barr
1990	J. C. Parsons
1991	C. E. Lanusse
1992	D. G. Baker
1993	R. A. Cole
1994	R. M. Kaplan
1995	S. T. Storandt
1996	A. L. Willingham III
1997	C. C. Siefker

Distinguished Service

1976	R. R. Bell
1987	N. F. Bake
1988	D. E. Cooperrider
1994	S. D. Folz
1997	H. Ciordia

AMERICAN ASSOCIATION OF VETERINARY PARASITOLOGISTS
Founded 1956

Officers 1997-1998

President	James Williams Louisiana State University Baton Rouge, LA
President-Elect	Lou Gasbarre ARS, USDA, LPSI Beltsville, MD
Vice-President	Robert Rew Pfizer Animal Health Exton, PA
Secretary/Treasurer	Thomas Kennedy Bayer Animal Health Merriam, KS
Past-President	Peter Schantz CDC, NCID Atlanta, GA

Committee Chairs

Archives:
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Cornell University
Ithaca, NY

Awards:
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Eli Lilly and Co.
Greenfield, IN

Constitution/Bylaws:
Tom Klei
Louisiana State University
Baton Rouge, LA

Education:
Bert Stromberg
University of Minnesota
St. Paul, MN

Finance:
Ray Kaplan
University of Georgia
Athens, GA

Historian:
Raf Roncalli
Merck & Co
Rahway, NJ

Internet:
Charles Courtney
University of Florida
Gainesville, FL

Newsletter:
Linda Mansfield
Michigan State University
East Lansing, MI

Nominations:
Kevin Kazacos
Purdue University
West Lafayette, IN

Outreach/Research:
Michael Dryden
Kansas State University
Manhattan, KS

Program:
Robert Rew
Pfizer Animal Health
Exton, PA

Publications:
Lora Ballweber
Mississippi State University
Mississippi State, MS

Student Awards:
T. Bonner Stewart
Louisiana State University
Baton Rouge, LA

AMERICAN ASSOCIATION OF VETERINARY PARASITOLOGISTS

AD HOC COMMITTEES

Representative to Fed. Soc. Parasitology	R. Fayer
Student Participation	J. Matthews
Presentation Quality	C. Courtney
Outreach for American Animal Hospital Association	A. Marchiondo

LIAISON TO . . . . . .

American Association of Bovine Practitioners	C. Speer
American Association of Equine Practitioners	J. DiPietro
American Association of Small Ruminant Practitioners	J. Miller
American Association of Veterinary Immunologists	L. Gasbarre
American Heartworm Society	J. McCall
American Society for Animal Science	J. Trischler
American Society of Parasitologists	R. Grieve
Australian Society for Parasitology	N. Sangster
American Association of Avian Pathologists	L. MacDougald
British Society of Parasitologists	G. Coles
Canadian Assoc. Advancement of Veterinary Parasitology	R. Pritchard
Central States Veterinary Conference	R. Arther
Council of Research Workers in Animal Disease	B. Stromberg
Council for Agricultural Science and Technology	T. Kennedy
Livestock Insect Workers Conference	P. Scholl
Livestock Conservation Institute	R. Fayer
National Beef Cattlemens' Association	G. Myers
National Pork Producers Council	J. Urban
New Zealand Animal Production Society	T. Watson
New Zealand Parasitology Society	T. Watson
Society for Neuroscience	D. Thompson
Southeastern Society of Parasitologists	D. Lindsay
U.S. Animal Health Association	J. P. Dubey
Western Veterinary Conference	M. Healey
Wildlife Diseases Association	D. Worley
World Assoc. for the Advancement of Vet. Parasitology	O. Slocombe

Registration – 43rd Annual Meeting
Ballroom Foyer, Renaissance Hotel
Saturday 25 July, 2:00-7:00 PM
Sunday 26 July, 8:00AM-5:00PM

SPEAKER READY ROOM
Mount Washington 7AM-6PM Daily

SOCIAL PROGRAM

BAYER ANIMAL HEALTH RECEPTION
Saturday, 25 July 1998
Maryland C Ballroom, Renaissance Hotel
7:00-9:00 PM

FORT DODGE ANIMAL HEALTH RECEPTION
Sunday, 26 July 1998
Maryland C Ballroom, Renaissance Hotel
7:00-9:00 PM

PFIZER ANIMAL HEALTH RECEPTION
Monday, 27 July 1998
Maryland Science Center
7:00-10:00 PM

PAST PRESIDENTS OF THE AMERICAN ASSOCIATION OF VETERINARY PARASITOLOGISTS

1956-1958	L.E. Swanson
1958-1960	F. R. Koutz
1960-1962	W. H. Krull
1962-1964	S. M. Gaafar
1964-1966	E. D. Besch
1966-1968	G. C. Shelton
1968-1970	J. H. Greve
1970-1972	H. J. Griffiths
1972-1973	D. E. Cooperrider
1973-1975	D. L. Lyles
1975-1977	H. J. Smith
1977-1979	N. F. Baker
1979-1981	E. L. Roberson
1981-1983	J. F. Williams
1983-1985	J. B. Malone
1985-1986	R. M. Corwin
1986-1987	K. D. Murrell
1987-1988	T. R. Klei
1988-1989	H. C. Gibbs
1989-1990	B. E. Stromberg
1990-1991	R. K. Pritchard
1991-1992	J. O. D. Slocombe
1992-1993	R. Fayer
1993-1994	G. Conder
1994-1995	C. Courtney
1995-1996	B. Blagburn
1996-1997	P. Schantz
1997-1998	J.C. Williams

AMERICAN ASSOCIATION OF VETERINARY PARASITOLOGISTS
SPONSORS-43rd ANNUAL MEETING

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* Provided Student Speaker Awards
** Provided honorarium for the Distinguished Veterinary Parasitologist
*** Provided honorarium for Graduate Student Award

The American Association of Veterinary Parasitologists gratefully acknowledges the above corporations for their support and sponsorship of the 1998 Annual Meeting

American Association of Veterinary Parasitologists
43rd Annual Meeting
Renaissance Harborplace Hotel, Baltimore, Maryland

SATURDAY, 25 July 1998		SUNDAY, 26 July 1998		MONDAY, 27 July 1998		TUESDAY, 28 July 1998
FEDERAL HILL ROOM		**MARYLAND A**	**MARYLAND B**	**MARYLAND A**	**MARYLAND B**	**CONVENTION CNTR RM 343**
AAVP Board Meeting Noon-2:30		Session 3:Cattle, sheep and goats 8:00-9:30 AM	Session 4: Dog/Cat Parasites 8:00-9:30 AM	Session 9: Sharks, swine and cattle 8:00:-9:30 AM	Session 10: Horses 8:00-9:30 AM	AAVP/AVMA Symposium: Current Knowledge and Practical Applications in Livestock Parasitisms 8–12:00
		Break 9:30 – 10:00 AM		Break 9:30 – 10:00 AM		
BALLROOM LOBBY		**MARYLAND B**		**MARYLAND A**	**MARYLAND B**	
Registration 2:00-7:00		AAVP SYMPOSIUM ON EMERGING/ OPPORTUNISTIC DISEASES 10:00-Noon		Session 11: Education 10:00-11:00 AM	Session 12: Biological Control 10:00-11:00 AM	
				Business Meeting **MARYLAND A & B** 11:00 - Noon		
		Lunch Noon-1:30 PM		Lunch Noon-1:30 PM		
BALTIMORE A & B						
Opening Remarks President J. C. Williams Vice Pres. & Prog. Chair R. Rew 3:00-3:30 PM		**MARYLAND B**		**MARYLAND A**	**MARYLAND B**	
		Presidential Address & Awards: 1:30-2:30 PM		Session 13:Cattle – pharmacology and treatment 1:30-3:00 PM	Session 14: Dog nematodes 1:30-3:00 PM	
		Break 2:30-3:00 PM				
BALTIMORE A	**BALTIMORE B**	**MARYLAND A**	**MARYLAND B**			
Session 1: Swine 3:30-4:30 PM	Session 2: Other Hosts 3:30-4:30 PM	Session 5:Nematode Cytology & Biochemistry 3:00-4:00 PM	Session 6: Diagnostics 3:00-4:00 PM	Break 3:00-3:30 PM		
Break 4:30-5	Break 4:30-5			**MARYLAND B**		
BALTIMORE	**A & B**	Break 4:00-4:30	Break 4:00-4:30	Session 15: Late Breaking Session 3:30-5:00PM		
Merial First Annual Symposium: Ticks and Tick - Transmitted Diseases of Companion Animals 5:00-7:00 PM		Session 7: Protozoa 4:30-6:00 PM	Session 8: Immunology – Poultry, Cattle, Sheep 4:30-6:00 PM	**MARYLAND B** Pfizer Immunology Symposium: 5:00-6:30PM		
		Break 6:00-6:30 PM				
MARYLAND C		**MARYLAND C**		**MARYLAND SCIENCE CENTER**		
BAYER RECEPTION 7:00-8:30 PM MARYLAND C		FORT DODGE RECEPTION 6:30-8:00 PM		PFIZER RECEPTION 7:00-10:00 PM		
		GRADUATE STUDENT MIXER- 8:00-10:00 PM MARYLAND A				

American Association of Veterinary Parasitologists
43rd Annual Meeting
Renaissance Harborplace Hotel, Baltimore, Maryland

PROGRAM

Saturday, July 25, 1998

12:00-2:30 ***AAVP Board Meeting***
Federal Hill Room

2:00-7:00 ***Registration***
Ballroom Lobby

3:00 **Opening Remarks**
Room: Baltimore A&B
President: JC Williams
Vice President & Program Chairman: R Rew

Session I **Room: *Baltimore A***
Topic: Swine
Moderators: J Urban, D Murrell

3:30 1. The Effect of Maternal Immunity on Experimental *Ascaris suum* Infection in Piglets. J Boes, M Varady, L Eriksen, A Roepstorff, P Nansen, S Coates, G Medley

3:45 2. Efficacy of Moxidectin 0.5% Pour-On Against Swine Nematodes. TB Stewart, SE Wiles, JE Miller, RD Rulli

4:00 3. Characterization of Protective Immune Response in Pigs After *Toxoplasma gondii* Infection. JK Lunney, G Solano-Aguilar, JP Dubey

4:15 4. Cell Types in the Lymphoglandular Complex Follicle of *Trichuris suis* – Infected Gnotobiotic Pigs with *Campylobacter* Invasion. DT Gauthier, JF Urban and LS Mansfield

Session II **Room: *Baltimore B***
Topic: Other Hosts
Moderators: K Kazacos, G Conder

3:30 5. Recurrent Diarrhea and Giardiasis in Spider Monkeys. N Guselle, V Honeyman, ME Olson

3:45 6. Visitation by Vertebrates to Raccoon Latrines: Its Importance in the Transmission of *Baylisascaris procyonis*. LK Page, RW Swihart, KR Kazacos

4:00 7. Demodicosis in an American Bison. R Ridley, J Vestweber and J Nietfeld

4:15 8. Characterization of *Trichinella* Larvae Recovered from Walruses in the Canadian Arctic. L Forbes, D Leclair, G Falk, A Gajadhar

4:30 **BREAK**

5:00 **MERIAL FIRST ANNUAL SYMPOSIUM**
Room: *Maryland A&B*
Topic: Ticks and Tick Transmitted Diseases of Companion Animals
Moderator: J Guerrero

5:00 9. Biology and Characteristics of Ticks of Importance to Small Animals and Man. TN Mather

5:30 10. Co-Infection with Multiple Tick-Transmitted Pathogens in Dogs. EB Breitschwerdt

6:00 11. The Prevention-Protection Concept Against Ticks and Tick Transmitted Diseases in Pets. AK Eschner

6:30-7:00 BREAK

7:00 - 9:00 BAYER ANIMAL HEALTH RECEPTION
Room: *Maryland C*

Sunday, July 26, 1998

Session III **Room: *Maryland A***
Topic: Cattle, Sheet and Goats
Moderators: A Zajac, B Blagburn

8:00 12. Protective Efficacy of Doramectin Pour-On Solution Against Establishment of Lice Infestations of Cattle. LL Smith, TL Skogerboe

8:15 13. Persistent Efficacy of Doramectin in Sheep. BE Stromberg, GA Averbeck, CJ Christians

8:30 14. Variation in Resistance to Trichostrongyle Parasites in Goats. A Zajac, T Gipson

8:45 15. Benefits of Fenbendazole in Treating Giardiasis in Dairy Calves. R O'Handley, ME Olson, T McAllister, M Jelinski

9:00 16. A Longitudinal Study of *Giardia* and *Cryptosporidium* in Beef Calves. B Ralston-Chalmers, TA McAllister, ME Olson

9:15 17. Biological Characterization of an Isolate of *Cryptosporidium muris* from a Naturally Infected Dairy Cow. DS Owens, CC Dykstra, SA McCrillis, MA Cheadle, BL Blagburn

Session IV **Room: *Maryland B***
Topic: Dog/Cat Parasites
Moderators: D Bowman, K Snowden

8:00 18. Antifeeding Response to Repellency Effect of an Antiflea Product. F Ascher, JP Boyd, O Elfassy

8:15 19. Antifeeding Response to Knock-Down Effect of an Antiflea Product. F Ascher, JP Boyd, O Elfassy

8:30 20. Dose Selection of UK-124,114, A Novel Avermectin, for Efficacy Against Fleas (*Ctenocephalides felis*) on Dogs and Cats. TL McTier, MS Holbert, AD Jernigan, TG Rowan, CD Smothers, CJ Giles, BF Bishop, NA Evans, KAF Gration

8:45 21. Prevalence of Exposure to *Dirofilaria immitis* in Cats in Multiple Areas in the United States. M Miller, C Atkins, K Stemme, C Robertson, J Guerrero

9:00 22. Rapid Detection of *Ehrlichia canis* in Dogs with Acute or Latent Infection. JS Mathews, SA Ewing, JR Malayer, JC Fox, KM Kocan

9:15 23. Canine Encephalitozoonosis. K Snowden, E Didier

9:15-10:00 BREAK

Sunday, July 26, 1998 (Cont.)

10:00 AAVP SYMPOSIUM

Room: *Maryland A&B*

Topic: EMERGING and OPPORTUNISTIC DISEASES

Moderator: J Lunney

10:00 24. From Oysters to Man: Parasitic and Toxic Dinoflagellates in the Chesapeake Bay. GR Vasta

10:30 25. *Cyclospora cayetanensis*: An Emerging Protozoan Pathogen. CR Sterling

11:00 EPM-AnEmerging Disease C Fenger

11:30 27. *Cryptosporidium*: An Opportunistic Disease. SJ Upton

12:00 - 1:30 LUNCH

1:30 - 2:30 PRESIDENTIAL ADDRESS & AWARDS

Room: *Maryland A&B*

2:30 - 3:00 BREAK

Session V Room: *Maryland A*

Topic: Nematode - Cytology and Biochemistry

Moderators: C Lanusse, B Hammerberg

3:00 28. *Haemonchus contortus*: Its Amphidial Cell Bodies, Their Identification, and Verification of Their Identity by Laser Ablation. J Li, FT Ashton, HR Gamble, GA Schad

3:15 29. TGF-Beta 2 in Pregnancy-Induced Reactivation of Arrested Hookworm Larvae. D M Kwak, J Therrien, P Arasu

3:30 30. Characterization of a Globin-Like Protein from *Haemonchus contortus*. RH Fetterer, DE Hill, ML Rhoads

3:45 31. Comparative Uptake of Albendazole and Albendazole Sulphoxide by Helminth Parasites *in vivo* and *in vitro*. L Alvarez, F Imperiale, S Sanchez, J Sallovitz, C Lanusse

Session VI Room: *Maryland B*

Topic: Diagnostics

Moderators: A Donoghue, B Grieve

3:00 32. Assessment of Culture and PCR Assay for the Implementation of a Reliable Diagnostic Method for Bovine Trichomoniasis. S Parker, ZR Lun, G Falk, J Campbell, A Gajadhar

3:15 33. A Sensitive PCR Assay for the Detection of *Tritrichomonas foetus* in Cattle. ZR Lun, A Gajadhar

3:30 34. Performance of a Feline Heartworm Antibody Lateral Flow Test Cassette. A Donoghue, RR Mondesire, KA Krause, PM Pace, N Guevara

3:45 35. Identification of Semi-Quantitation of *Ostertagia ostertagi* Eggs by Enzymatic Amplification of Its-1 Sequences. DS Zarlenga, LC Gasbarre, P Boyd, E Leighton, JR Lichtenfels

4:00 36. Assessment of Excretory-Secretory Products and Somatic Worm Antigens for the Serological Diagnosis of *Parelaphostrongylus tenuis* Infection in White-Tailed Deer. O Ogunremi, A Gajadhar

4:00 - 4:30 BREAK

Sunday, July 26, 1998 (Cont.)

Session VII **Room: *Maryland A***

Topic: Protozoa

Moderators: R Fayer, T Geary

4:30 37. Determination of the Activity of Nitazoxanide Against *Sarcocystis neurona* in Cell Cultures. DS Lindsay, Y Zhang, JP Dubey, K Palma

4:45 38. Epidermal Growth Factor (EGF) Inhibits Intestinal Colonization with *Cryptosporidium parvum.* ME Olson, AG Buret, J Hardin, DG Gall

5:00 39 Survival of G*iardia* Cysts and *Cryptosporidium Oocysts* in Water, Soil and Cattle Feces. ME Olson, J Goh, M Phillips

5:15 40. Viability of *Tritrichomonas foetus* Field Isolates in Transport and Culture Media at Various Temperatures. G Falk, ZR Lun, AA Gajadhar

5:30 41. *In vivo* Stage Conversion of *Toxoplasma gondii.* JP Dubey

5:45 42. Experimental *Cochlosoma anatis* Infections in Poultry. DS Lindsay, C Larsen, A Zajac, FW Pierson

Session VIII **Room: *Maryland B***

Topic: Immunology - Poultry, Cattle, Sheep

Moderators: D Hill, T Kennedy

4:30 43. Immunization of Chickens with Plasmid DNA Encoding Recombinant *Eimeria acervulina* Antigen Via Jet-Gun Injection Elicits Immunity Against Coccidiosis. M Jenkins, P Allen, H Danforth, P Augustine

4:45 44. Kinetics of IFN-Gamma Gene Expression in the Intestine Following *E. acervulina* Infection. KD Choi, HS Lillehoj, DS Zarlenga, M Nichols

5:00 45. Evaluation of Con A H11-HgalGP Vaccine in Suffolk Lambs. MT Pena, EK Kabagambe, JE Miller, WD Smith, S Barras, Y Li

5:15 46. Responses to Mitogen-Stimulation and to Immunization with an Unrelated Antigen of Cattle Naturally Infected with Gastrointestinal Nematodes after Transport to a Feedlot. LC Gasbarre, T Gomez-Munoz, S Almeria, A Canals, J Guerrero, C Robertson

5:30 47. Local Immune Responses Induced After Primary and Challenge Infections of Cattle with Either *Ostertagia ostertagi* or *Haemonchus placei.* A Canals, T Gomez, S Almeria, DS Zarlenga, LC Gasbarre

5:45 48. Effect of Previous Exposure on Establishment of Cattle Nematodes after Natural Challenge Exposure on Contaminated Pasture. JC Williams, LC Gasbarre, TR Klei, A DeRosa, M Chapman

6:00-7:00 BREAK

7:00 - 9:00 FORT DODGE ANIMAL HEALTH RECEPTION
Room: *Maryland C*

8:00- 10:00 GRADUATE STUDENT MIXER
Room: *Maryland A*

Monday, July 27, 1998

Session IX **Room: *Maryland A***

Topic: Sharks, Swine and Cattle

Moderators: M Doscher, T Craig

8:00 49. A Novel Class of Steroids Isolated from the Dogfish Shark (*Squalus acanthias*) Induce a Reversible Spherocytosis in Normal Erythrocytes and Kill Erythrocytic Stages of *Plasmodium falciparum* RM Kaplan, W Kinney, MA Zasloff

8:15 50. Relationship Between Swine *Ascaris* Infection and Visceral Larval Migrans in Humans from Pig Farming Areas in Kyushu, Japan. K Ishiwata, Y Nawa, Y Horii, F Uchiyama

8:30 51. Migration and Development of *Ascaris suum* Larvae in *Erythrocebus patas:* Model for Visceral Larva Migrans in Humans. J Urban, T Rasmussen, A Cheever, L Eriksen, P Nansen, D Murrell

8:45 52. Field Efficacy of Strategically Administered Anthelmintics in Cow-Calf Management Systems in Mountainous Areas of Spain. S Almeria, J Uriarte, R Revilla

9:00 53. Measurement of Drug and Mineral Intake in Individual Animals on Range. ME Olson, BJ Ralston-Chalmers, TA McAllister, CL Cockwill, D Milligan

9:15 54. Survival and Development of Eggs of *Fasciola hepatica* on Pasture During the Summer in Florida. RM Kaplan, BR Kreitz, CH Courtney

Session X **Room: *Maryland B***

Topic: Horses

Moderators: J Di Pietro, C Fenger

8:00 55. A Controlled Bridging Study in Equines to Compare the Therapeutic Bioequivalence of 0.5% Fenbendazole Top Dress Pellets and 10% Fenbendazole Suspension Administered Orally. DE Hutchens, AJ Paul, JA DiPietro, CJ Jones, TF Lock

8:15 56. Effectiveness of Moxidectin for Benzimidazole and Pyrantel Resistant Cyathostomes in Horses. O Slocombe, R DeGannes

8:30 57. Recent Advances in the Identification and Classification of Small Strongyles of Horses. JR Lichtenfels, VA Kharchenko, RC Krecek, LM Gibbons

8:45 58. Characterization of *Giardia* Recovered from a Horse. ME Olson, N Mutlow, N Guselle

9:00 59. Cytokine Gene Expression to *Strongylus vulgaris* Infection in Immune and Nonimmune Ponies. TR Klei, CP Swiderski, MR Chapman, S Pourciau, R Moore,JR McClure, DW Horohov

9:30-10:00 BREAK

Session XI **Room: *Maryland A***

Topic: Education

Moderators: C Courtney, R Lichtenfels

10:00 60. Daniel Elmer Salmon -- A Parasitologist in His Own Right. R A Roncalli

10:15 61. Veterinary Parasitology Web Site. J Nahm, RM Corwin

10:30 62. Computer-Aided Learning - A Tool for Teaching or Technological "Overkill"? C Johnstone

10:45 63. Life Cycle of *Eimeria tenella*. W Raether, M Uphoff, J Hofmann

Monday, July 27, 1998 (Cont.)

Session XII **Room: *Maryland B***

Topic: Biological Control

Moderators: R Fetterer, A Marchiondo

10:00 64. Histological Evaluation of Effect of Neem Leaf Extract of *Haemonchus contortus*: *In Vitro* Study. M Johal, J Singh

10:15 65. Efficacy of *Dudingtonia flagrans* in Reducing Infective Equine Cyathostome L3 on Pasture in Southern Louisiana. MA Baudena, M Larsen, TR Klei

10:30 66. Entomopathogenic Nematodes as Control Agents of Developmental Stages of the Black-Legged Tick *Ixodes scapularis*. D E Hill

10:45 67. Larvicidal Activity of Crystal Toxin of *Bacillus thuringiensis* to *Haemonchus contortus* - Fourth Stage Larvae. Y Baoan, W Xiang, X Xueshan, Z Jinlong, Y Ziaiu

11:00 - 12:00 Business Meeting

12:00 - 1:30 LUNCH

Session XIII **Room: *Maryland B***

Topic: Cattle - Pharmacology and Treatment

Moderators: T Letonja, C Reinemeyer

1:30 68. Distribution of Endectocide Compounds to Target Tissues in Cattle. A Lifschitz, G Virkel, J Sutra, P Galtier, M Alvinerie, C Lanusse

1:45 69. Field and Control Trial Determinations of Moxidectin Effectiveness in the Treatment of Naturally Acquired Bovine Nematodosis. TA Yazwinski, C Tucker, RM Cleale, GT Wang

2:00 70. Comparison of Ivermectin Topical vs. A Combination of Fenbendazole, Permethrin and Fenthion in Feedlot Calves. PT Guichon, CW Booker, GK Jim, OC Schunicht, JR Brown

2:15 71. Persistent Efficacy of Doramectin Pour-On Solution Against Artificially-Induced Infections of *Dictyocaulus viviparus* in Cattle. B Stromberg, B Woodward, G Averbeck

2:30 72. Persistent Efficacy of Doramectin Against *Haemonchus placei* Infections in Cattle. TA Yazwinski, C Tucker, Z Johnson, D Walstrom

2:45 73. Efficacy and Productivity Responses of Dectomax® - Treated Stocker Calves in Alabama. RE Blaylock, JP Pollreisz and RS Rew

Session XIV **Room: *Maryland A***

Topic: Dog - Nematodes

Moderators: B Arther, S Barr

1:30 74. The Prevalence of Gastrointestinal Nematode Parasites in Well-Cared-for Pet Dogs in the East Coast of the USA. G Smith, G Schad

1:45 75. The Prevalence of Endoparasites of Dogs and Cats in Shelters and the Effect of Anthelmintic Protocols. M O'Brien, TJ Nolan

2:00 76. Studies of Filariasis of Dogs in Los Angeles County, CA. Local Vectors of *Dirofilaria immitis* TH Theis, R Saviskas

Monday, July 27, 1998 (Cont.)

2:15 77. Studies on Filariasis of Dogs in Los Angeles County, CA, July 1, 1996 through August 31, 1997. TH Theis, F Stevens

2:30 78. *Angiostrongylus vasorum* Infection in Dogs in Newfoundland, Canada. G Conboy, H Whitney, S Ralhan

2:45 79. Environmental Contamination by Puppies Infected with *Toxocara canis*. KR Kazacos

3:00 **BREAK**

Session XV **Room: *Maryland B***

Topic: Late Breaking Session

Moderator: S. Marley

3:30 80. Experimental Transmission of *Hepatozoon americanum* to Dogs by the Gulf Coast Tick, *Amblyomma maculatum*. JS Mathew, SA Ewing, RJ Panciera, JP Woods

3:40 81. Equine Protozoal Myeloencephalitis (EPM): Seroprevalence and Risk Factors in Michigan Horses. MG Rossano, JB Kaneene, LS Mansfield

3:50 82. New Molecular Methods for Pathogen Detection. J Higgins

4:00 83. Evaluation of Melarsomine Dihydrochloride (Immiticide®) for Adulticidal Activity Against *Dirofilaria immitis* in Cats. LW McLeroy, JW McCall, MT Dzimianski, N Supakorndej

4:10 84. Persistent Efficacy of Doramectin Topical Solution Against Artificially-Induced Infestations of *Bovicola bovis* and *Solenopotes capillatus* in Cattle. L Smith, J Lloyd, J Waggoner, M Grubbs, R Kumar, E Norelius

4:20 85. Persistent Efficacy of Doramectin Injectable Solution Against Artificially-Induced Infections of *Ostertagia ostertagi* in Cattle. CR Reinemeyer, FM Andrews, TL Skogerboe, JM Cunningham, DJ Walstrom

4:30 86. Preventing Transmission of *Sarcoptes scabiei* var. *suis* Infestations from Sows to Nursing Piglets by a Prefarrowing Treatment with Doramectin Injectable Solution. LD Firkins, CJ Jones, DP Keen, JJ Arends, L Thompson, TL Skogerboe

4:40 87. Efficacy of Moxidectin Oral Gel Against *Gasterophilus nasalis* and *Gasterophilus intestinalis* Infections in Horses. CR Reinemeyer, FM Andrews, DW Rock, PJ Scholl

4:50 26. *In vitro* Modulation of T cell stimulation by *Ostertagia ostertagi* extracts. MT Gomez-Munoz, A Canals, S Almeria,P Pasquali, D Zarlenga & LGasbarre

5:30 **PFIZER SYMPOSIUM *Maryland B***

Topic: Immunology

Moderator: R. Rew

5:30 88. Parasite Vaccines: Insights into Building New Biological Weapon Systems for Testing at the Host-Pathogen Front. DA Brake

5:45 89. The Hidden Antigen Approach to Parasite Vaccines. N Wisnewski

6:00 90. Tick Modulation of Host Immunity: An Important Factor in Pathogen Transmission. SK Wikel, GB Schoeler

7:00 - 10:00PM PFIZER ANIMAL HEALTH RECEPTION

Maryland Science Center

Tuesday, July 28, 1998

AAVP/AVMA PRESIDENT'S SYMPOSIUM

Convention Center - Room 343
Topic: Introduction to Current Knowledge and Practical Applications in Livestock Parasitism
Moderator: J.C. Williams

8:00 91. Current Knowledge and Practical Applications in Livestock Parasitism: Introductory Remarks. JC Williams

8:30 92. Diagnostic, Immunologic and Genetic Aspects of Nematode Parasitism in Cattle. LC Gasbarre

9:00 93. Practical Control of Nematode Parasitism in Cattle. BE Stromberg

9:30-10:00 BREAK

10:00 94. Current Control Methods for Ectoparasites. PJ Scholl

10:30 95. Bovine Neosporosis: Epidemiology and Impact. JP Dubey

11:00 96. Diagnosis, Epidemiology and Control of Liver Fluke Infections in Cattle. JB Malone

1

The effect of maternal immunity on experimental *Ascaris suum* infection in piglets.

J. BOES*, M. VARADY, L. ERIKSEN, A. ROEPSTORFF, P. NANSEN, S. COATES & G. MEDLEY.
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Two studies were carried out to investigate if sows infected with *Ascaris suum* transfer protective immunity to their piglets. In the first study 5 gilts were immunized with 10,000 eggs twice weekly for 9 months, starting at 6 months before gestation, while 5 gilts served as parasite naive controls. The second study had the same design except that (a) the gilts were only immunized during gestation (14 weeks) with increasing doses (10,000 to 100,000 eggs) and (b) litters from 2 immune and 2 control sows were cross-suckled. All newborn piglets from immunized and control sows were inoculated with low doses of infective eggs (2 x 50 eggs) within the first week of life and necropsied 10 weeks later. In the first study the prevalence of infection was significantly higher ($P<0.001$) in piglets born to immune sows (89%) compared to piglets born to control sows (52%), while mean worm burdens were comparable (control: 9.9, immunized: 11.4), suggesting that immunized sows transfer a form of immunotolerance to their offspring. However, in the second study the prevalence did not differ significantly between the two groups (control: 62.7%, immunized: 54.4%), but the mean worm count was significantly lower in the piglets from immune sows (5.6 vs. 16.1 in controls, $P<0.001$) indicating transfer of protective maternal immunity. The cross-suckled piglets that were placed with immune sows remained largely worm-free (15.4% harboured worms) in contrast to the piglets placed with control sows (61.9% infected). Worm counts in all litters were overdispersed and followed a negative binomial distribution. Using linear regression of the parameter *k* on worm counts it was found that a curvilinear relationship exists between prevalence and mean *A. suum* counts in piglets from both immune and control sows, suggesting that at any given prevalence of infection, piglets from control sows have a higher worm burden than piglets from infected sows. Maternal antibodies but also the duration of exposure of sows to *A. suum* infection may influence the establishment of patent infections in suckling piglets, resulting in different prevalences of infection.

2

Efficacy of moxidectin 0.5% pour-on agaisnst swine nematodes. T.B. STEWART[1]*, S.E. WILES[1], J.E.MILLER[1], R.D. RULLI[2]. SCHOOL OF VETERINARY MEDICINE, LOUISIANA STATE UNIVERSITY, BATON ROUGE, LA 70803[1] AND FT. DODGE ANIMAL HEALTH, PRINCETON NJ 08543[2].

Forty pigs with induced infections of *Ascaris suum, Trichuris suis, Metastrongylus* spp., *Oesophagostomum dentatum* and *O. quadrispinulatum* were assigned to five dose groups of moxidectin 0.5% pour-on with 8 pigs per dose group. The doses were 0 (vehicle control), 0.75, 1.00, 1.25, and 1.50 mg/kg body weight. Worm egg counts (EPG) were made from fecal samples collected on Day -2 pretreatment and for Day 14 or 15 posttreatment. Animals were ranked according to the descending order of *A. suum* egg counts made on Day -2 and blocked in groups of five. Pigs in blocked groups were assigned randomly to each of the five dose groups. Treatment doses were calculated on the basis of weights taken on day -1 and were administered topically from the neck to the base of the tail. Pigs were housed in individual pens provided with self-feeders and automatic wateres. Necropsies were performed on equal number of pigs from each treatment group on Day 14 and 15 posttreatment. Adult and larval worms were collected, identified and counted by standard parasitological techniques. All counts were transformed by $Y=\log_{10}(\text{count}+1)$ transformation prior to analysis. A two-way analysis of variance was conducted and treatment effect was tested for significance at the 5% level. Efficacies based on geometric means were as follows: *Ascaris suum,* 98.3%; *Metastrongylus* spp. 100%; *Oesophagostomum quadrispinulatum*, 99.1% and *Trichuris suis* , 94.9%. Efficacy for *O. dentatum* was from 81.3 to 100%, however the average number of *O. dentatum* (30) was too small for significance. The optimum dose for *A. suum* was 1.25 and 0.75 for *Oesophagostomum* and *Metastrongylus*. Two species of lungworms were present, *Metastrongylus apri* and *M. pudodentectus* but they were not speciated at necropsy. As reported for several anthelmintics, the efficacy of moxidectin was variable for *Trichuris*. The highest efficacy was in the 0.75dose group with 7 pigs harboring a few or no worms. The lowest efficacy was in the 1.25 group with only 3 pig harboring a few or no worms.

3

CHARACTERIZATION OF PROTECTIVE IMMUNE RESPONSE IN PIGS AFTER *TOXOPLASMA GONDII* INFECTION. J. K. LUNNEY*, G. SOLANO-AGUILAR, & J.P. DUBEY. IMMUNOLOGY AND DISEASE RESISTANCE LABORATORY, & PARASITE BIOLOGY AND EPIDEMIOLOGY LABORATORY, LPSI, ARS, USDA, Building 1040, Room 105, BELTSVILLE, MD 20705.

The present study was designed to evaluate the cell subsets and cytokines which lead to protective immunity in pigs against toxoplasmosis. Recent field surveys have shown a continuing prevalence of this foodborne disease. The major strategy for prevention of toxoplasmosis in swine is the identification of resistance factors and of vaccines or specific *T. gondii* antigens which induce protective responses. Despite the extensive literature on immunity to *T. gondii* in mice and humans, almost nothing is known of swine immune responses to this infection. Serologic titers have been reported for swine but these are highly variable and, as with other species, not predictive of effective immunity. This study was designed to define the protective immune response to *T. gondii* infection and to determine whether genetic background would influence resistance to this infection. A group of 24 piglets of different swine leukocyte antigen (SLA) haplotypes were evaluated for a period of 6 weeks after infection with ~500 *T. gondii* oocysts. Cells subsets from peripheral blood were tested using a broad panel of monoclonal antibodies (mAb) that identify the most important swine B and T cell subsets. Due to the important role of the immune cytokine, interferon-γ (IFN- γ), in the prevention of human and murine *T. gondii* infection, we tested the ability of swine peripheral blood lymphocytes to produce this cytokine using the cytokine specific capture ELISA. Parasite burden was assessed in tongue and brain tissues from all pigs after necropsy by bioassay in mice and cats to determine whether genetically resistant pigs can be identified. These studies should provide valuable information on controlling toxoplasmosis in pigs.

4

Cell Types in the Lymphoglandular Complex Follicle of *Trichuris suis*-infected Gnotobiotic Pigs with *Campylobacter* invasion. D.T. GAUTHIER*[1], J.F. URBAN[2], and L.S. MANSFIELD[1].
[1]Michigan State University, East Lansing, MI 48824; [2]USDA, Beltsville, MD 20705

Young, conventionally reared pigs infected with *Trichuris suis* develop severe mucohemorrhagic diarrhea due to worm-induced invasion of the large intestinal mucosa and lymphoglandular complexes (LGC) of the distal colon by resident bacteria. To examine *Campylobacter* invasion in the LGC, gnotobiotic pigs were infected with *T. suis* (250 eggs/kg) and/or *C. jejuni* (10^6 CFU ATTC 33292). Pigs with both agents had mucohemorrhagic diarrhea and severe pathology in the colon at 27 days post-infection. Pigs with *T. suis* or *C. jejuni* alone, or no pathogens, had no disease or pathology at this time. LGCs were enlarged in the *T. suis* & *C. jejuni* group. The lymphocyte types in LGCs from all groups were immunohistochemically analyzed using monoclonal antibodies for cell surface IgM, IgA, IgG, CD4, CD8, MHC II, CD21 and SWC3. LGCs of all infection groups contained distinct T- and B-cell dependent regions. B-cells were primarily IgM^+ and found in the mucosal region of the follicle. $CD4^+/CD8^+$ T-cell areas occupied basal regions of LGC follicles. Germinal centers were present only in *C. jejuni*-infected pigs (+ or – for *T. suis*), and displayed Ig class switching, primarily to IgA^+. The number of IgA^+ cells in the follicle and lamina propria was increased in these pigs. Most cells in LGC follicles were MHC II^+, with negative cells found in T-dependent regions. Macrophages were seen in the lamina propria and connective tissue surrounding LGC follicles. Due to their lymphocyte composition and response to exogenous antigen, we conclude LGCs are significant antigen processing structures in the pig colon.

5

RECURRENT DIARRHEA AND GIARDIASIS IN SPIDER MONKEYS

NICOLE GUSELLE*, VIRGINIA HONEYMAN, MERLE E. OLSON
DEPARTMENT OF GASTROINTESTINAL SCIENCES, UNIVERSITY OF CALGARY AND THE CALGARY ZOO, CALGARY, ALBERTA

A group of spider monkeys in the Calgary Zoological Park developed recurrent diarrhea. *Giardia* was the only gastrointestinal pathogen identified in the feces. Animals responded to fenbendazole (50 mg/kg q24 for 5 days). The *Giardia* successfully infected Mongolian gerbils and was axenically cultured in TYI-S-33 media. The morphology of *Giardia* isolated from the spider monkeys was characterized by light and scanning electron microscopy. SDS Page electrophoresis and western blot analysis were used to biochemically and antigenically characterize the isolate and compare it to other mammalian strains. The isolate was indistinguishable from human strains. These *Giardia* isolates present a potential zoonotic threat to zoo keepers and visitors exposed to the contaminated feces. Giardiasis may be an important clinical disease in non-human primates.

6

VISITATION BY VERTEBRATES TO RACCOON LATRINES: ITS IMPORTANCE IN THE TRANSMISSION OF *BAYLISASCARIS PROCYONIS*.

L.K. PAGE[1], R.W. SWIHART[1], AND K.R. KAZACOS*[2]. DEPARTMENTS OF FORESTRY AND NATURAL RESOURCES[1] AND VETERINARY PATHOBIOLOGY[2], PURDUE UNIVERSITY, WEST LAFAYETTE, IN 47907.

Raccoons (*Procyon lotor*) frequently establish latrines on large logs, stumps, rocks, and other horizontally-oriented structures/surfaces. These latrines are important foci of infective eggs of the raccoon ascarid, *Baylisascaris procyonis*. To examine the role of raccoon latrines in the transmission of *B. procyonis* to mammals and birds, we examined animal visitation to such sites in two large forested tracts and two woodlots in Indiana over a 2 year period. Species richness of vertebrate visitors did not differ between sites or years, but species composition differed by site and year. Fourteen mammal and 15 bird species were documented visiting raccoon latrines. Small granivorous mammals, including white-footed mice (*Peromyscus leucopus*), eastern chipmunks (*Tamias striatus*), and tree squirrels (*Sciurus carolinensis, S. niger, Tamiasciurus hudsonicus*) were the most frequent visitors to latrines. White-footed mice, chipmunks, nuthatches (*Sitta carolinensis*), and opossums (*Didelphis virginiana*) were documented foraging on undigested seeds in raccoon feces. Active foraging at latrines was also shown experimentally, when seeds embedded in raccoon feces were removed at a greater rate at latrines than at nonlatrines. We concluded that raccoon latrines are visited routinely by a variety of vertebrates, especially small granivorous rodents and birds which forage for seeds in raccoon feces, and that raccoon latrines are the primary sites of transmission of *B. procyonis* to susceptible mammals and birds in nature. Supported by grant 96-35101-3129 from the U.S. Department of Agriculture.

7

DEMODICOSIS IN AN AMERICAN BISON. ROBERT K. RIDLEY*, JERRY VESTWEBER and JEROME NIETFELD. COLLELGE OF VETERINARY MEDICINE, KANSAS STATE UNIVERSITY, MANHATTAN, KS 66506.

An 18 month-old male American bison (*Bison bison* L.) calf grazing the Konza prairie near Manhattan, KS was observed during the annual fall roundup of a 240 head herd to have multiple pea size swellings, most of which were 7-9mm in diameter, around the eyes, perineum, and on the ventral surface of the proximal portion of the tail. Smaller lesions could be felt on the neck, shoulders and flanks. The bison calf appeared to be of normal size, condition, and basic physical parameters were normal. We could not immediately identify his mother to see if she was affected. Several of the lesions were excised ventrally, and the cream-colored, caseous material characteristic of bovine demodicosis was examined. *Demodex* sp. mites were readily identified from this material. Biopsies from lesions around the eyes were also obtained following local anesthesia. Histopathological examination revealed a folliculitis with the presence of *Demodex* sp. mites. Microscopically, in the mid- and deep-dermis there was a thick bank of multifocal, coalescing inflammation in which there was an absence of intact hair follicles. The inflammation consisted predominantly of neutrophils with smaller numbers of macrophages, lymphocytes, and plasma cells. Blood was obtained from the demodicosis calf and from a control calf for lymphocyte blastogenesis studies. Concanavalin A, Pokeweed mitogen and Phytohemagglutinin were used as mitogens. No statistical differences were seen between cells obtained from the demodicosis calf and the control.

8

CHARACTERIZATION OF *TRICHINELLA* LARVAE RECOVERED FROM WALRUSES IN THE CANADIAN ARCTIC. LORRY FORBES*[1], DANIEL LECLAIR[2], GLORIA FALK[1] & ALVIN GAJADHAR[1]. [1]CENTRE FOR ANIMAL PARASITOLOGY, CANADIAN FOOD INSPECTION AGENCY, SASKATOON, CANADA; [2]NUNAVIK RESEARCH CENTRE, MAKIVIK CORP., KUUJJUAQ, QUEBEC, CANADA.

Several early reports described *Trichinella* larvae in walrus meat (Greenland, 1950; Canada, 1954; Russia, 1965), but subsequent surveys showed a low prevalence of the parasite in the walrus population. Despite this, several outbreaks of human trichinellosis have been linked to the consumption of walrus meat. In one report clinical signs indicated that the pathogenesis of human trichinellosis in the arctic differed from that seen in temperate climates and the authors suggested this was due to infection with a walrus strain of the parasite. Until recently, isolates of *Trichinella* from walruses have not been available for characterization. Using a pepsin-HCl digestion method, the Nunavik Research Centre detected two *Trichinella*-infected walruses which were destined for human consumption by the Inuit population of northern Quebec. Subsequent samples were submitted to the Centre for Animal Parasitology in Saskatoon where further studies were initiated. Mice, guinea pigs and rats were orally inoculated with the walrus strain. Cold tolerance studies at -20°C and -70°C were conducted and the strain was biotyped using PCR. The results show that the isolate was adapted to freeze resistance, and the consumption of previously frozen infected tissues could result in human trichinellosis.

9

Biology and Characteristics of Ticks of Importance to Small Animals and Man

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Ticks can be significant ectoparasites as well as important vectors of disease to companion animals and their owners. Knowledge of ecological and physiological processes associated with ticks and their hosts are critical in developing effective strategies to prevent infestations and block disease transmission. Climatic factors likely are important in regulating the spatial distribution of some species of ticks, especially deer ticks which transmit Lyme disease, babesiosis and ehrlichiosis to animals and man. Moreover, tick saliva contains a virtual pharmacist's shelf of biologically-active compounds that assist the tick in overcoming host hemostasis and aid in pathogen transmission. Taken together, these factors help explain vector competence and ultimately the patterns of host infestation and infection.

10

Co-infection with Multiple Tick-Transmitted Pathogens in Dogs. Edward B. Breitschwerdt* D.V.M., College of Veterinary Medicine, North Carolina State University, Raleigh, NC.

Recently, simultaneous infection with more than one tick-borne pathogen has been recognized in human patients. Although retrospective seroepidemiologic studies suggest that dogs may experience simultaneous infection with multiple tick-borne pathogens, microbiologic (culture) or molecular (PCR) evidence of simultaneous infection in dogs is currently lacking. In nature, the risk of exposure to ticks is far greater for dogs than for human beings. In addition, dogs can be infested with hundreds of ticks, and at times infestation may involve different tick species. Therefore, the unknown influences of concurrent infection with multiple tick-borne pathogens, including *Ehrlichia, Rickettsia, Babesia* and *Bartonella* species on factors such as diagnosis, prognosis or therapeutic outcome could be more readily characterized in dogs. For example, during the summer of 1997, our laboratory investigated a cluster of sick dogs, with accompanying mortality, for microbiologic, serologic and molecular evidence of tick-borne infections. Of 27 dogs, 25 were seroreactive to a *Ehrlichia* sp., 20 to a *Bartonella* sp., 17 to a *Babesia* sp. and 22 seroconverted to *R. rickettsii* antigen. Based upon PCR analysis, several dogs were co-infected with multiple *Ehrlichia* species, as well as a *Bartonella, Babesia* or *Rickettsia* sp.. Our recent experience indicates that dogs with heavy tick exposure can be infected at a high rate with multiple, potentially zoonotic, tick-borne pathogens.

11

Title: The Prevention-Protection concept against ticks and tick transmitted diseases in pets.

Andrew K. Eschner, D.V.M.

ABSTRACT: Ticks have been the bane of animals and man for thousands of years. In recent years, tick-borne diseases have been on the rise across the United States in both humans and companion animals. Historically, tick control in companion animals has principally been achieved via permethrin-based acaracides and environmental management. Fipronil, a new phenylpyrazole acaracide introduced in the United States in 1996, represents the latest advance in external tick control and elimination in household pets. In addition, recent advances in recombinant DNA technology have afforded the means to prevent the transmission of the tick-borne disease known as canine borreliosis (Lyme Disease). The mechanism of action of this Type I recombinant vaccine is by elimination of the causative organism within the mid-gut of the primary tick vector. The combination of external tick control (fipronil) and the novel approach to preventing the transmission of tick-borne Lyme disease in dogs (Type I recombinant Lyme vaccine) exemplifies the goals of the prevention-protection concept for control of ticks and tick-borne disease in companion animals.

12

Protective Efficacy of Doramectin Pour-On Solution Against Establishment of Lice Infestations of Cattle. L. L. SMITH*, RESEARCH AND DEVELOPMENT, INC. LODI, WI AND T. L. SKOGERBOE, PFIZER ANIMAL HEALTH, LEE'S SUMMIT, MO.

A 112-day study was conducted to evaluate the protective efficacy of doramectin administered topically at a dose rate of 500 μg/kg to lice-free beef calves (cleared of pre-existing infestations) housed with calves infested with *Linognathus vituli*, *Solenopotes capillatus*, or *Haematopinus eurysternus* and *Bovicola bovis*. A second group of lice-free beef calves served as non-medicated controls. Twenty beef-crossbred calves were randomly and equally allotted to two treatment groups (doramectin-treated; non-medicated controls) and 10 pens (5 replicates/treatment). Ten other calves that were infested with at least 50 sucking and 50 biting lice each were randomly selected from a pool of seeder calves and placed into pens with the principal animals (1 seeder/pen). Seeder animals were replaced with 10 other seeder calves every 14 days. Lice counts were performed on 9 defined predilection regions every 7 days during the study. *L. vituli* and *B. bovis* counts were significantly ($P \leq 0.05$) lower in the doramectin-treated calves from day 7 through day 112, compared to those for the non-medicated calves. Calves treated with doramectin pour-on solution demonstrated significantly delayed acquisition of *L. vituli* and *B. bovis* infestations, compared to the non-medicated calves.

13

PERSISTENT EFFICACY OF DORAMECTIN IN SHEEP. B.E. STROMERG*, G.A. AVERBECK AND C.J. CHRISTIANS. DEPARTMENTS OF VETERINARY PATHOBIOLOGY AND ANIMAL SCIENCE, UNIVERSITY OF MINNESOTA, ST. PAUL, MN 55108.

A study was conducted to evaluate the persistent efficacy of doramectin injectable solution against a natural parasite infection in sheep and lambs. Ewes were randomly allotted into two groups. On day 0 one group (treated) was injected subcutaneously with 1cc of doramectin, while the second group remained untreated (control). All lambs and ewes were rotationally grazed together on one of four pastures that were rotated weekly. Fecal egg counts were conducted weekly throughout the study. Weights of ewes and their lambs were taken at the start of the study, at weaning 56 days later and day 112. At weaning the ewes were removed from the pasture and the study continued with the lambs only. Lambs of treated and control ewes remained in the the same groups for the second part of the study. Lambs in the treated group were given doramectin (1cc SC) on day 56, while the control lambs remained untreated. The lamb study was terminated on day 112.

Fecal egg counts of the ewes were about 290 epg at the start of the study. The counts from the treated ewes went to 0 by day 7 and remained low through day 35. On day 56 the control ewes had fecal egg counts of 990 epg and the treated ewes were 106 epg. The ewes in both groups lost about 32lb from turnout to weaning. The average fecal egg counts for the lambs at weaning was about 670 epg. After treatment lamb egg counts remained low through day 98 (42 days pt) and had increased to over 1027 epg by day 112. The egg counts from the control lambs peaked at over 5000 on day 105 and had fallen to 3460 epg by day 112. The nursing lambs of treated ewes gained 20.81 lb while the control group gained 21.81 lb. After weaning the treated lambs gained an average of 12.69 lb compared to 8.88lb for the controls over the next 56 days.

14

Variation in Resistance to Trichostrongyle Parasites in Goats. Anne Zajac*, Virginia-Maryland Regional College of Veterinary Medicine, Virginia Tech, Blacksburg VA 24061 and Terry Gipson, Agricultural Research Station, Virginia State University, Petersburg VA 23806.

Gastrointestinal trichostrongyles, especially *Haemonchus contortus*, are important parasites of goats in the southeastern U.S. Goats often require frequent anthelmintic treatment to prevent disease and/or death and anthelmintic resistance is increasing in the region. One means of reducing the frequency of deworming is utilization of natural variation in parasite resistance. Total worm burdens were evaluated in at least 4 goats of each of the following breeds: Nubian, Pygmy, Spanish, Myotonic and Virginia Brush goats. The lowest worm burdens were found in Myotonic and Pygmy goats. Worm burdens in these 2 breeds were significantly lower than worm burdens of Nubian and Spanish goats. Fecal egg counts (FEC) and blood Packed Cell Volumes (PCV) were also followed in small groups of Nubian, Pygmy, Spanish and Myotonic goats during late pregnancy and early lactation. Differences between lactating and nonlactating goats were seen in both PCV and FEC during the post-kidding period and a larger proportion of lactating than nonlactating goats required treatment before the end of the study. Spanish and Nubian goats appeared to be most affected by parasitism following kidding.

15

BENEFITS OF FENBENDAZOLE IN TREATING GIARDIASIS IN DAIRY CALVES

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GASTROINTESTINAL RESEARCH GROUP, UNIVERSITY OF CALGARY, CALGARY ALBERTA; AGRICULTURE AND AGRIFOOD CANADA, LETHBRIDGE ALBERTA, HOECHST ROUSSEL VET, REGINA, SASKATCHEWAN

Giardiasis has been shown to be common and a chronic infection in dairy calves. Fenbendazole has been shown to effectively eliminate *Giardia* from the intestine of calves. This study determined the economic and therapeutic benefits of fenbendazole treatment of giardiasis in commercial dairy calves. Sixty *Giardia* infected Holstein calves, approximately 4 weeks of age were allocated to a fenbendazole treatment group or a control group. The treatment group received oral fenbendazole (5mg/kg q24h for 3 days) every 28 days, while the control group recieved saline. Calves were weighed weekly for 14 weeks and daily feed intake was recorded. Fecal examinations for intestinal parasites were performed weekly. Fenbendazole significantly reduced *Giardia* cysts excretion following treatment but reinfection occurred after 2 weeks post treatment. *C. parvum* was observed in the first 2 weeks of study in both groups, however other intestinal parasites were not observed. There was no significant difference in average daily gain or feed efficiency between the fenbendazole treatment group and control. During the study, there was significantly ($P<0.05$) fewer days with diarrhea in the fenbendazole treated calves compared to controls. Fenbendazole is an effective agent in the treatment of giardiasis but reinfections may occur. Monthly treatment does not provide performance benefits, but reduces the incidence of diarrhea.

16

A LONGITUDINAL STUDY OF *GIARDIA* AND *CRYPTOSPORIDIUM* IN BEEF CALVES

BRENDA RALSTON-CHALMERS*, TIMOTHY A. MCALLISTER, MERLE E. OLSON
GASTROINTESTINAL RESEARCH GROUP, UNIVERSITY OF CALGARY, CALGARY ALBERTA; AGRICULTURE AND AGRIFOOD CANADA, LETHBRIDGE ALBERTA.

Both *Giardia* and *Cryptosporidium* have been demonstrated in beef and dairy calves. We have demonstrated that 100% of dairy calves are infected with these parasites, but little is known about the biology of these parasites, particularly in beef calves where management is different. The aim of this study was to determine the prevalence and pattern of naturally occurring *Giardia* and *Cryptosporidium* infections in beef calves. Fecal samples from 20 beef calves were collected weekly from birth to 9 weeks of age and 3 times throughout the summer grazing period. *Giardia* cysts, *Eimeria*, *C. parvum* and *C. muris* oocysts were enumerated. *Giardia* was present in 100% of the beef calves with peak infections occurring between weeks 4 and 8. Twenty percent of calves cleared the infection by the end of the study. Only 1 calf (5%) was infected with *C. parvum*. In this herd, naturally occurring *Giardia* infections were prevalent from shortly after birth throughout the grazing period, but *C. parvum* was rarely observed. In beef cattle, it appears that *Giardia* infections and environmental contamination are more significant than with *Cryptosporidium*

17

BIOLOGICAL CHARACTERIZATION OF AN ISOLATE OF *CRYPTOSPORIDIUM MURIS* FROM A NATURALLY INFECTED DAIRY COW. D. S. OWENS, C.C. DYKSTRA, S. A. McCRILLIS, M.A. CHEADLE AND B. L. BLAGBURN*. COLLEGE OF VETERINARY MEDICINE, AUBURN UNIVERSITY, AL 36849

Oocysts of *Cryptosporidium muris* were detected in the feces of a 5-year-old Holstein dairy cow (Cow No. 806) during a coproprevalence survey of East Central Alabama dairy herds. Only 1 (source animal in this report) of 238 cows was passaging oocysts consistent morphometrically with those of *C. muris*. Fifty oocysts were measured for comparison to oocyst dimensions reported for *C. muris* in prior reports. Numbers of oocysts shed in the naturally infected cow was monitored using a quantitative sucrose flotation technique twice daily (morning and afternoon) for 21 days, and then weekly on a continuing basis. Oocysts were purified from feces and experimentally inoculated into five, 8-day-old broiler chicks, five, adult (2 to 3-year-old) pygmy goats, five, 98-day-old ICR Swiss Mice, five, 98-day-old BALB/c mice, and five, 66-day-old athymic mice. Feces of recipient animals were monitored by sucrose flotation for passage of oocysts of *C. muris*. Oocysts recovered from feces were ovoid and measured 7.3 (6.0-8.1) X 5.5 (5.0-6.5) μm. Each contained a compact residual body with 1 to several distinct granules. Cow 806 has shed oocysts of *C. muris* consistently since our first positive fecal sample on August 20, 1997. Twice daily fecal samples revealed that numbers of oocysts present in morning samples were numerically greater than those recovered in afternoon samples. However, numbers were identical when corrected for content of fecal dry matter. To date, oocysts have not been recovered from the feces of chicks, goats or mice experimentally inoculated with *C. muris* oocysts.

18

ANTIFEEDING RESPONSE TO REPELLENCY EFFECT OF AN ANTIFLEA PRODUCT

Frédéric ASCHER, J. Pat BOYD**, Olivier ELFASSY**
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Since allergic dogs can react to flea bites, the objective of this test was to evaluate the antifeeding response [AR] to an antiflea formulation with a test specially designed to assess its repellency effect. 8 Pointer dogs (mean weight 19.3 kg) were split into 2 groups of 4 each : one non-treated group [NTR] and 1 group treated once with a spot-on solution based on 40% permethrin + 0.3% pyriproxyfen [DCO] (Duowin Contact®, Virbac®, 8 ml/dog). The test was designed to simulate a naturally occurring flea population exposed to and infesting a host animal. Weekly for 6 weeks, 100 adult fleas were released into a stainless steel box before a caged dog was placed into the box for a 10 min. exposure period. The dog was then transferred for 30 min. to an adjacent second box which was free of fleas. Fleas found in the two boxes and on the dog 40 min. post-exposure onset were counted and removed. All fleas were bioassayed to determine if they had ingested blood. AR was related to the percentage of fleas that did not induce any coloured reaction to the blood test kit. Based on all the fleas collected from boxes and dogs, AR was recorded at all assessments for 6 weeks in the DCO group. When combining the antifeeding data for each week, 91 %, 69% and and 71% of the fleas exposed to DCO did not feed before leaving the animals at week 1, 2 and 3 respectively. Early repellency, higher levels of fleas in box 1, increased the prevention of flea feeding. Most of the fleas remaining on the dogs had fed. The early AR to DCO treatment supports its use for control of FAD.

Weeks	Antifeeding : % of fleas that did not feed (boxes 1 & 2 + dogs)		Repellency : % of fleas that were repelled found in box 1		found in boxes 1 & 2	
	NTR	DCO	NTR	DCO	NTR	DCO
1	3.27	90.61	0.48	99.53	0.25	72.74
2	4.76	69.38	2.15	96.72	2.15	65.54
3	12.19	71.39	5.00	97.92	5.00	43.21
4	4.23	41.06	2.75	66.15	2.75	22.56
5	8.67	32.57	2.64	56.05	2.64	15.55
6	13.34	41.06	5.59	44.39	5.59	7.47

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ANTIFEEDING RESPONSE TO KNOCK-DOWN EFFECT OF AN ANTIFLEA PRODUCT

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Chemicals are known to affect the behaviour of insects in numerous ways and FAD control is related to prevention of flea bite. The objective of this test was to evaluate the antifeeding response [AR] to an antiflea formulation with a test designed to assess its knock-down effect. 8 Pointer dogs (mean weight 19.3 kg) were split into 2 groups of 4 each : one non-treated group [NTR] and 1 group treated once with a spot-on solution based on 40% permethrin + 0.3% pyriproxyfen [DCO] (Duowin Contact®, Virbac®, 8 ml/dog). Each dog was infested weekly with 100 adult *Ctenocephalides felis* for 6 weeks. Fleas that fell off the dog after their release were counted at 15, 30, 60, 120 and 240 min. intervals. 4 hrs after each infestation the fleas remaining on the dogs were counted and removed. All fleas were bioassayed to determine if they had ingested blood. The AR developed only for DCO at any point during the 6 week period, with a maximum of 97.92% of the fleas remaining unfed within 4 hours at week 1. DCO provided a trend in the AR that almost duplicated the knock-down effect at week 1 and 2 and that overlapped this effect in weeks 5 to 6. Within 60 min., 97% and 97% of the whole fleas collected and bioassayed provided an AR for week 1 and 2 respectively. Quicker the fleas fell off the dogs, the less likely they were to be fed. The strong AR to DUO supports its use for control of FAD.

Weeks	Antifeeding : % of fleas that did not feed within 4 hrs.		Knock-down : % of fleas that fell of the dogs within 15 min.		Knock-down : % of fleas that fell of the dogs within 1 hr.	
	NTR	DCO	NTR	DCO	NTR	DCO
1	10.45	97.92	4.08	91.46	4.08	99.40
2	12.89	97.31	2.96	89.24	2.96	99.75
3	6.87	76.95	4.23	56.41	4.23	88.22
4	9.66	76.80	6.24	58.51	6.48	85.12
5	15.26	69.79	6.78	44.91	6.78	63.43
6	12.58	66.19	4.82	34.27	4.82	51.42

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DOSE SELECTION OF UK-124,114, A NOVEL AVERMECTIN, FOR EFFICACY AGAINST FLEAS (*CTENOCEPHALIDES FELIS*) ON DOGS AND CATS.

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UK-124,114, a novel avermectin, was discovered by artificially feeding adult *Ctenocephalides felis* fleas on blood incorporating the test material. The minimum effective concentration of UK-124,114 in this assay was 0.25 µg/mL. To determine an appropriate dose against infestations of *C. felis* on dogs and cats, UK-124,114 was administered in controlled studies as a single topical dose. In one study, 48 beagle dogs (24 males and 24 females) were used. A separate study used 48 domestic shorthair cats (24 males and 24 females). For each study, animals were allocated randomly to four treatment groups of 12 animals each. One treatment group was administered placebo, and the remaining three treatment groups were administered a single topical dose of 3 mg/kg, 6 mg/kg, or 9 mg/kg of UK-124,114. On day 0 in each study, UK-124,114 was administered as a topical dose which was applied in a single spot at the base of the neck in front of the shoulder blades. Dogs and cats were infested with 100 viable unfed *C. felis* on days 4, 11, 18, and 27. Approximately 72 hours after each infestation, on days 7, 14, 21, and 30, a comb count of the number of viable fleas present on each animal was made. Efficacy of UK-124,114 on day 30 was used to select an appropriate dose. For day 30 flea comb counts for both dogs and cats, analysis of variance showed that the three UK-124,114-treatments had significantly lower counts ($P \leq 0.05$) than did placebo. Flea counts for the 3 mg/kg treatment were significantly higher ($P \leq 0.05$) than for the 6 mg/kg and 9 mg/kg treatments combined. There were no significant differences in flea counts ($P > 0.10$) between the 6 mg/kg and 9 mg/kg treatments. This indicated that an appropriate dosage of UK-124,114 for 30-day efficacy against adult fleas on dogs and cats was 6 mg/kg. This analysis was confirmed by linear plateau modeling. On day 30, percentage reductions for the 6 mg/kg dose against fleas on dogs and cats were 94.7% and 98.0%, respectively. Thus, these studies demonstrated the effectiveness of UK-124,114 administered in a single topical application against fleas for 30 days on dogs and cats.

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Prevalence of Exposure to *Dirofilaria Immitis* in Cats in Multiple Areas in the United States. M. MILLER[1], C. ATKINS[2], K. STEMME[3], C. ROBERTSON[3]*, J. GUERRERO[3]. [1]TEXAS A&M UNIVERSITY COLLEGE OF VETERINARY MEDICINE, COLLEGE STATION, TX[2] NORTH CAROLINA STATE UNIVERSITY COLLEGE OF VETERINARY MEDICINE, RALEIGH, NC [3]MERIAL LIMITED, ISELIN, NJ

Information regarding the prevalence of feline heartworm disease and exposure in the United States is presently inadequate, partly due to limitations of currently available diagnostic methodology. Currently available antigen tests for *D. immitis* are less sensitive in the cat when compared to the dog because of the more frequent presence of single sex infections (associated with low worm burdens), and also because immature worms not yet producing detectable circulating antigen may cause substantial pathology in cats. Echocardiography allows detection of worms located in the heart or proximal pulmonary arteries, but may miss worms in distal pulmonary arteries or in aberrant locations. Necropsy may not establish a definitive diagnosis due to the relatively small size of immature worms, the tendency of dead and dying worms to fold and embolize to small distal pulmonary arterioles, the relatively short lifespan of the worms and the relatively high potential for aberrant infections. Tests have been developed that detect circulating antibodies directed against the fourth and fifth larval stage of *D. immitis*. Studies using an experimental infection model have suggested that these tests are both sensitive and specific indicators of exposure, defined as the successful transmission and molting of heartworm larvae in cats. This survey was designed to determine the prevalence of circulating antibodies *to D. immitis* in cats from multiple areas in the United States using a commercially available test. Approximately 20 areas of the United States will have been surveyed. Approximately 100 cats from each area will have been entered into the survey. Four or five private small animal hospitals in each area will have collected sera from feline patients. The sites will have been chosen based on the number of cats for which they provide veterinary service. Sites also will have been selected in an attempt to stratify submissions in a radius around a city center. Cats included in the survey will have been at least 12 months of age and must have lived in the area for at least 12 months. Cats receiving heartworm preventive medication will not be not enrolled in the survey. Final analysis of the survey results will be presented.

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Rapid detection of *Ehrlichia canis* in dogs with acute or latent infection. J. S. MATHEW*, S. A. EWING[1], J. R. MALAYER[1], J. C. FOX[1] and K. M. KOCAN[2]. DEPARTMENT OF INFECTIOUS DISEASES & PHYSIOLOGY[1]; DEPARTMENT OF ANATOMY, PATHOLOGY & PHARMACOLOGY[2]; OKLAHOMA STATE UNIVERSITY; STILLWATER, OK 74078

Accurate detection of *Ehrlichia canis* infections in acutely infected and convalescent dogs is important for effective treatment and control; however, this has been difficult to achieve, in part, because dogs that have been cured therapeutically often remain seropositive for extended periods. Five methods were used to detect *E. canis* in experimentally infected dogs, viz., microscopy/blood smear evaluation, serologic evaluation, slot-blot hybridization using a 369bp oligonucleotide probe labeled with digoxigenin, polymerase chain reaction (PCR) assay using *E. canis*-specific primers followed by agarose gel electrophoresis and ethidium bromide staining, and PCR assay performed using the same primers labeled with biotin followed by dot-blotting with a rapid avidin-biotin detection system. Dogs were exposed to *E. canis* infection by intravenous inoculation of whole blood from carrier dogs. Daily blood smear evaluation and slot-blot hybridization both detected infection 14-18 days post exposure. Seroconversion occurred at 14-21 days and conventional PCR assay detected infection 9-12 days post exposure. The PCR assay using biotinylated primers detected the parasite as early as 7 days post exposure. This most sensitive method corroborated findings in an earlier study which demonstrated that *E. canis* can be transmitted by blood transfusion as early as 7 days after an "incubating donor" dog is, itself, exposed to that agent. PCR assay using signal amplification with avidin-biotin also proved to be a rapid method to distinguish true carriers from cured dogs that are persistently seropositive.

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CANINE ENCEPHALITOZOONOSIS

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Parasites of the Phylum Microspora are rarely reported as pathogens in immunocompetent mammalian hosts. Interest has recently focused on this group of parasites as "opportunistic infections" in immunocompromised humans. Within the last 15 months, fatal systemic microsporidiosis has been diagnosed in 3 litters of puppies and 1 adult dog in Texas. Puppies demonstrated neurologic disease, while the adult dog had endstage renal disease. Prominent histologic lesions included non-suppurative inflammation and vasculitis in the brain, meninges and/or kidneys. Parasites were consistently identified in the brain and/or kidney, and were sometimes present in the meninges, heart, liver, lymph node or spleen. Organisms were morphologically compatible with *Encephalitozoon cuniculi.* Using molecular sequencing of a portion of the small subunit ribosomal RNA gene, the identity of the parasites was confirmed as *E. cuniculi.* Several isolates were further characterized as *E. cuniculi* Type III, using molecular analysis of the ITS region of ribosomal DNA. The Type III parasites have also been reported in humans, and demonstrate minor differences from rodent or rabbit isolates. Further study is needed to evaluate the importance of dogs as reservoirs of infection, and the role of dogs in possible zoonotic transmission of the parasite.

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From Oysters to Man: Parasitic and Toxic Dinoflagellates in the Chesapeake Bay. G. R. VASTA*, CENTER OF MARINE BIOTECHNOLOGY, UNIVERSITY OF MARYLAND BIOTECHNOLOGY INSTITUTE, 701 EAST PRATT ST., BALTIMORE, MD 21202.

Parasitic and toxic dinoflagellates constitute detrimental factors for aquaculture, fisheries and human health in the Chesapeake Bay region and other coastal areas of US. Mass mortalities due to parasitic infections by *Perkinsus marinus* ("dermo"), have caused a critical reduction of existing oyster populations and have affected commercial harvests. Impaired human health has been associated to recent fish kills in Chesapeake Bay tributaries, and have been attributed to the toxic dinoflagellate, *Pfiesteria piscicida*. There is a clear need to address a variety of problems related to environmental monitoring and disease diagnosis, prevention and remediation, as well as those associated with shellfish and finfish as possible vectors of disease. We are currently applying biochemical and recombinant DNA approaches to the basic questions of detection, identification and enumeration of dinoflagellates in the environment and their hosts, and to gain insight in their mechanisms for proliferation and life cycle transformations. We developed a polymerase chain reaction-based assay for the diagnosis of *P. marinus* in oyster tissues selecting an intergenic non-transcribed spacer in the rRNA locus as the target nucleotide sequence. The assay is species-specific and can detect a single *P. marinus* trophozoite in 30 mg of oyster tissue, indicating that this diagnostic methodology is not only faster, but also more reliable than current assays. We are currently developing similar tests for the environmental detection of *Pfiesteria* -like dinoflagellates.

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CYCLOSPORA CAYETANENSIS: AN EMERGING PROTOZOAN PATHOGEN

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Cyclospora cayetanensis is a newly recognized coccidian parasite infecting humans. Symptomatic and asymptomatic infections with this parasite have been described and are markedly seasonal. Disease caused by *Cyclospora* is characterized by mild to severe nausea, anorexia, abdominal cramping and watery diarrhea. *Cyclospora* has now been described from patients with protracted diarrheal illness in North, Central and South America, the Caribbean, Africa, Bangladesh, Southeast Asia, Australia, England and Eastern Europe. Routes of transmission are still unknown, although the fecal-oral route, via water, is the probable major one. A recent outbreak in the United States was epidemiologically linked to the ingestion of contaminated raspberries imported from Central America, implying a foodborne route of transmission.
Cyclospora oocysts can be detected by phase contrast microscopy, modified acid fast staining, autofluorescence under UV light and by PCR. Oocysts are excreted in feces unsporulated and require 1-2 weeks under ideal conditions to become sporulated. Sporulated oocysts are required to initiate infection. Each sporulated oocyst contains two sporocysts and each sporocyst contains two sporozoites. Typical apicomplexan structures are observed by electron microscopy.
Evidence to date points to man being the primary and perhaps only host for this protozoan parasite. Asexual meronts and sexual gametocytes have been observed in parasitophorous vacuoles within the cytoplasm of enterocytes. Histopathologic examination of jejunal biopsies from infected symptomatic patients showed a mild to moderate inflammation of the lamina propria and surface epithelial disarray disproportionate to the number of detectable parasites. Symptomatic infections caused by *Cyclospora* are treatable with Trimethoprim-sulfamethoxazole.

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In vitro immunomodulation of T cell stimulation by *Ostertagia ostertagi* extracs. M.T. GOMEZ-MUÑOZ*, A. CANALS, S. ALMERIA, P. PASQUALI, D. ZARLENGA & L.C. GASBARRE. USDA, ARS, LPSI, IMMUNOLOGY AND DISEASE RESISTANCE LABORATORY, BELTSVILLE, MD, 20705, USA.

Ostertagiasis is one of the most important parasitic diseases of cattle in temperate areas of the world. The prevalence of the parasite is very high because immunity to reinfection arises very slowly and it is not completely protective. *In vitro* studies carried out with bovine lymphocytes from uninfected animals have demonstrated the inhibitory effect of *O. ostertagi* extracts on the growth of stimulated T cells. This effect was most evident when L4 soluble extracts were used, is weaker with adult extracts of the parasite, and was completely absent when using L3 extracts. A dose dependent inhibition of T cell growth was observed when adding L4 extracts to Con A stimulated cultures. Flow cytometric analysis of cell surface markers showed that IL-2 Receptor expression was significantly depressed when L4 extract was present in the culture when compared with control stimulated cultures. Other surface markers showed no changes, except for a slight decrease in CD3+ lymphocytes in cultures containing the L4 extract. Induction of cytokine messenger RNA was also studied using a competitive RT-PCR technique. Levels of IL-2, IFN-g, IL-4 and IL-13 expression were consistently lower in Con A stimulated cells exposed to the L4 extract. In contrast, expression of downregulating cytokines such as TGF-b was slightly increased in cells exposed to the L4 extract, and this extract itself showed binding activity in an ELISA specific for human TGF-b.

M.T. Gómez-Muñoz has been covered by a postdoctoral fellowship from the University Complutense of Madrid, Spain.

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Cryptosporidium: an opportunistic disease. S.J. UPTON*, DIVISION OF BIOLOGY, KANSAS STATE UNIVERSITY, MANHATTAN, KS 66506.

Cryptosporidium parvum is a ubiquitous gastrointestinal protozoan capable of causing diarrheal illness in both humans and animals. Oocysts have been reported from about 50% of all surface water samples collected by various investigators and, since the first report in 1983, 20 waterborne outbreaks affecting >100 individuals have been documented worldwide. 25-35% of all individuals in North America and Europe, and 60-75% of all individuals in third world countries, are seropositive. To date, >100 different mammalian species have been reported to be susceptible to infection. Ruminants appear to be an important source of oocysts in the environment, and calves may shed up to 20 billion oocysts in a single day. However, many adult animals shed low levels of oocysts throughout their lives, generally at levels ≤1% that neonates. These adults serve to keep the environment seeded with viable oocysts throughout the year. Two distinct genotypes of *C. parvum* exist; one type infects humans (and weakly, swine) whereas the second type infects both humans and a wide range of mammals. Well over 100 different types of disinfection strategies and physical insults have been used in an attempt to render sporozoites within oocysts non-viable; most with disappointing results. As a population, the parasite can easily withstand treatments such as 1% sodium hydroxide for 30 min, freezing at -10°C for 1 wk, 50% Pine-Sol for 30 min, 10% Clorox for 3 hr, 10% formalin for 1 wk, and 90% ethanol for 30 min. In public water treatment facilities, the most effective disinfection strategy appears to be ozonation at 1-2 mg/L for 5+ min. However, the most effective and economical method of controlling the parasite outside of the water industry is simply desiccation. Additional recent findings on the organism will be discussed.

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HAEMONCHUS CONTORTUS: ITS AMPHIDIAL CELL BODIES, THEIR IDENTIFICATION, AND VERIFICATION OF THEIR IDENTITY BY LASER ABLATION. J. LI, F.T. ASHTON, H.R. GAMBLE, AND G.A. SCHAD* UNIVERSITY OF PENNSYLVANIA, PHILADELPHIA. PA, AND USDA, ARS, PARASITE BIOLOGY AND EPIDEMIOLOGY LABORATORY, BELTSVILLE, MD

We seek to discover and identify the specific chemosensory neurons (amphidial neurons) that sense the arrival of the *Haemonchus contortus* infective larva in the host, and, as a consequence of this, initiate the processes that cause resumption of development by this larva. Identification of these neurons will provide a neurological basis for understanding the infective process. To identify the neurons of interest, these cells (amphidial neurons) have been reconstructed from transverse serial sections of the anterior ends of first stage larvae, using electron microscopy and computer-based imaging techniques. The reconstruction of the dendritic processes has been reported previously. Now we report the reconstruction and mapping of the amphidial neuronal cell bodies. Positional homology with the cell bodies of *Caenorhabditis elegans* allows for provisional neuronal identification. Mapping permits ablation of these individually recognized neurons, using differential interference microscopy and laser microsurgery. We are systematically killing the individual amphidial cell bodies in hatchling larvae and examining them by electron microscopy to confirm cell death as well as neuronal identity.

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TGF-beta2 in pregnancy-induced reactivation of arrested hookworm larvae.
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In the pregnant female, tissue-arrested *Anyclostoma caninum* L3 larvae are triggered to reactivate and transmit in milk to establish infections in the nursing neonates. Using BALB/c mice, we have been able to encapsulate this process for mechanistic studies of the role of pregnancy-associated hormones and cytokines. TGF-beta 2, which is regulated by estrogen and prolactin, does appear to provide a stimulus for reactivation. Using an *in vitro* feeding/reactivation assay, we find that tissue-arrested larvae are stimulated by physiological concentrations of TGF-beta 2, as well as normal serum, and that these effects can be blocked by pre-incubation with antibodies to TGF-beta. Canine sera from different stages of pregnancy showed a decline in stimulatory potential at parturition (which correlates with decreased levels of estrogen and prolactin), and an increase in stimulatory potential during lactation; TGF-beta 2 levels in these serum samples are being evaluated by ELISA. By genomic blot and PCR analyses, we find *A. caninum* sequences with homology to the *C. elegans* TGF-beta ligand (*daf*-7) as well as the TGF-beta like receptors (*daf*-1 and *daf*-4) cDNAs; in *C. elegans*, these DAF gene products are key players in entry and exit from the arrested phase. Cloning and further characterizations are underway to test our hypothesis that the increasing level of mammalian TGF-beta 2 during late pregnancy provides the initial signal for reactivation of arrested hookworm larvae; this signal could be mediated by TGF-beta like receptors on the amphidial chemosensory neurons of the parasite that are exposed to the environment.

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Characterization of a globin-like protein from *Haemonchus contortus*.
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A protein with characteristics of globin was purified from supernatants of *Haemonchus contortus* extracts by high pressure liquid chromatography. The purified protein had a Mr of 33 kDa under nondenaturing conditions and a Mr of 19 kDa by reducing SDS-PAGE suggesting the globin may exist as a dimer. Three peptides resulting from proteolytic digest of the purified globin were sequenced and had strong homology to other nematode globins particularly to that from *Trichostrongylus colubriformis*. The L3-stage lacked globin but the L4-stage contained a globin with Mr of 19.6 kDa. Adult *H. contortus* incubated overnight in ^{3}H-leucine, incorporated radioactivity into a peak that coeluted with globin indicating the adults synthesize globin in vitro. The globin is probably not secreted into the culture media in vitro. These result suggest that *H. contortus* contains and synthesizes a globin-like protein that may be a major constituent of the perienteric fluid. The function of this protein in nematode physiology remains unclear.

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Comparative uptake of albendazole and albendazole sulphoxide by helminth parasites *in vivo* and *in vitro*. L.ALVAREZ*, F.IMPERIALE, S.SANCHEZ,J.SALLOVITZ, C.LANUSSE. AREA FARMACOLOGIA, FACULTAD de CIENCIAS VETERINARIAS, UNIVERSIDAD NACIONAL del CENTRO, TANDIL, ARGENTINA.

It is well known that albendazole (ABZ) parent drug has a higher affinity for parasite tubulin than its sulphoxide metabolite (ABZSO). However, the comparative pattern of parasite uptake for these two molecules and its relationship with drug concentration profiles reached at the sites of parasite location need to be further understood. The current experiments correlate the drug/metabolite concentration profiles obtained in target tissues/fluids after ABZ administration to infected sheep, with the pattern of uptake by *Haemonchus contortus* collected from the same treated animals. Seventeen (17) *H. contortus* naturally-infected lambs were intraruminally treated with ABZ (7.5 mg/kg). Five animals were randomly chosen to obtain plasma samples over 120 h; two animals were sacrificed at 0.5, 1, 2, 4, 6 and 12 h post-treatment. *H. contortus*, abomasal and intestinal mucosas/fluids, bile, and liver samples were collected and processed by HPLC. The 12-h sampling period was chosen to evaluate parasite uptake during the drug absorption phase (plasma Cmax obtained at 12 h). Complementary studies were undertaken to compare the *in vitro* uptake of both molecules by nematodes (*Ascaris suum*) and cestodes (*Moniezia spp.*). ABZSO and ABZ-sulphone were recovered in plasma between 0.5 and 48 h post-treatment. ABZ and ABZSO were rapidly taken up by *H. contortus*, being detected in the parasite between 0.5 and 12 h post-administration. Both molecules were also recovered from all the tissues examined. A greater availability of ABZ parent drug compared to ABZSO, was observed both in abomasal mucosa and liver during the first 12 h post-treatment. Interestingly, drug/metabolite availabilities were greater in *H. contortus* (AUCs= 35 and 29 µg.h/g) than those found in abomasal mucosa (AUCs= 20.3 and 8.7 µg.h/g) and abomasal fluid (AUCs= 7.9 and 22.1 µg.h/ml, respectively). A significantly greater uptake of ABZ compared to ABZSO was observed following their incubation with both *A. suum* and *Moniezia spp. in vitro*. The greater *in vivo* and *in vitro* uptake of ABZ correlates with its higher lipophilicity compared to the more polar ABZSO.

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ASSESSMENT OF CULTURE AND PCR ASSAY FOR THE IMPLEMENTATION OF A RELIABLE DIAGNOSTIC METHOD FOR BOVINE TRICHOMONIASIS.
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New technologies have triggered the advent of new diagnostic tests. The currently accepted diagnostic test for *Tritrichomonas foetus* is culture and morphological identification of the organism. We have developed a PCR assay for *T. foetus* in our laboratory at the Center for Animal Parasitology. A number of aspects of a test need to be properly evaluated before it can be implemented by a diagnostic laboratory. These aspects will be addressed with respect to comparing culture and PCR diagnostics for *T. foetus*. Data from a field trial will be presented. Sensitivity, specificity, accuracy, and reliability using field samples will be discussed for the PCR assay and the culture test. Hurdles that need to be overcome in taking a test from the research laboratory to the field situation will also be discussed.

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A SENSITIVE PCR ASSAY FOR THE DETECTION OF *TRITRICHOMONAS FOETUS* IN CATTLE. ZHAO-RONG LUN* AND ALVIN GAJADHAR, CENTRE FOR ANIMAL PARASITOLOGY, CANADIAN FOOD INSPECTION AGENCY, SASKATOON, SASKATCHEWAN, CANADA

The small subunit ribosomal RNA gene was sequenced and used to design a pair of specific PCR primers for *Tritrichomonas foetus*. A PCR assay producing a 367 bp fragment was developed and evaluated for specificity on various microorganisms and isolates of *T. foetus* from various geographical regions of the world. False positive results did not occur with DNA from cattle, enteric tritrichomonads, *Campylobacter*, *Mycoplasma* or seven other species of bacteria. However, the PCR assay amplified the DNA of *Tritrichomonas suis* and *Tritrichomonas mobilensis*, enteric tritrichomonads of pigs and tree shrew, respectively. Genetic, morphological and other studies indicate that *T. foetus*, *T. suis* and *T. mobilensis* share similar characteristics. The PCR assay was also performed on spiked samples to evaluate sensitivity. As few as one parasite was detected in samples from *in vitro* cultivation or five parasites in samples containing bovine preputial smegma and blood. (Research was supported in part by the Canadian Food Inspection Agency's Matching Investment Initiative, Agriculture and Agri-Food Canada's Prairie Farm Rehabilitation Administration, and the Saskatchewan Beef Development Fund).

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Performance of a feline heartworm antibody lateral flow test cassette. AR DONOGHUE*, RR MONDESIRE, KA KRAUSE, PM PACE, ND GUEVARA. HESKA-CORPORATION, FORT COLLINS CO

A rapid immunoassay format for in-clinic use was developed incorporating a highly specific recombinant antigen (rHWAg1) as the capture agent for identification of IgG to *Dirofilaria immitis* in the cat. The format uses 100 µl of whole blood, plasma or serum applied to the sample well. The serum or plasma flows across the membrane and, if antibodies to *D immitis* are present, a red line develops in the results window. A blue procedural control line develops with all samples to indicate proper performance of the test. To evaluate the specificity of the test cassette, 100 serum samples from heartworm-naïve animals, 30 serum samples from cats naturally infected with one or more of *Toxocara cati*, *Ancylostoma tubaeforme*, *Aelurostrongylus abstrusus*, *Dipylidium caninum* and/or *Taenia taeniaeformis*, 120 serum samples from recently vaccinated, heartworm-naïve cats, and whole blood, plasma and serum samples from 20 heartworm-naïve cats were tested. To evaluate sensitivity, 25 serum samples each from cats with male worm-only infections, with female worm-only infections or with multiple worm infections, and 25 samples from cats with infections varying in age from 57 to 119 days were tested. Four samples from heartworm negative animals were positive for a specificity of 99% (n=277). For necropsy-confirmed, infected animals the sensitivity is listed in Table 1.

Table 1: Sensitivity of Heska's in-clinic feline heartworm test

Male-only n=25	Female-only n=25	Multiple worms n=25	Overall adult worm infections n=75	~ 60 days n=9	~ 90 days n=9	~ 120 days n=7
96	92	96	95	33	89	100

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IDENTIFICATION AND SEMI-QUANTITATION OF OSTERTAGIA OSTERTAGI EGGS BY ENZYMATIC AMPLIFICATION OF ITS-1 SEQUENCES. D.S. ZARLENGA[1*], L.C.GASBARRE[1], P.BOYD[1], E. LEIGHTON[2] AND J.R.LICHTENFELS[1]. [1]U.S. Department of Agriculture, ARS, Beltsville, Maryland 20705 and [2]The C-BAR Group, Great Falls, VA. 22066

A region within the first internal transcribed spacer (ITS-1) of the ribosomal DNA repeat of Ostertagia ostertagi has been identified that is 408 base pairs (bp) in length and is comprised of a 2 X 204 bp repeat. Universal polymerase chain reaction (PCR) primers which span this region, as well as a portion of the 5.8S rDNA, generate a 1011 bp fragment using genomic DNA from O. ostertagi. However, these same primers generate only a 600 (approximate) bp fragment using DNA from Haemonchus contortus, Cooperia oncophora and Oesophagostomum radiatum, as well as other species within the genus Ostertagia. When DNA samples derived from adult parasites of the different genera were mixed and simultaneously amplified, the O. ostertagi component could be identified within the mixed DNA populations. Furthermore, a correlation was observed between relative fluorescence intensities of the 1011 bp and the 600 bp PCR fragments and the percentage of O. ostertagi DNA within a mixture of parasite DNAs. A similar high correlation was obtained between the percentage of O. ostertagi DNA and percent O. ostertagi eggs in feces containing eggs of other nematode genera. This resulted in the generation of a protocol that can determine the percentage of O. ostertagi eggs within a mixed population of gastrointestinal nematode eggs. Results indicate a detection level equivalent to 0.05 eggs. Studies are in progress to assess the relationship between adult worm burdens, and percent Ostertagia eggs calculated by competitive PCR and by diagnosis of cultured third stage larvae.

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ASSESSMENT OF EXCRETORY-SECRETORY PRODUCTS AND SOMATIC WORM ANTIGENS FOR THE SEROLOGICAL DIAGNOSIS OF *PARELAPHOSTRONGYLUS TENUIS* INFECTION IN WHITE-TAILED DEER. Oladele Ogunremi and Alvin Gajadhar*, Centre for Animal Parasitology, Canadian Food Inspection Agency, Saskatoon, Canada; Murray Lankester, Lakehead University, Thunder Bay, Canada.

Parelaphostrongylus tenuis is a protostrongylid nematode found in the brain of white-tailed deer (WTD). The parasite has been found in the eastern half of North America but not in the west. Although it can cause debilitating or fatal disease in a variety of wild and domesticated animal species there is no reliable diagnostic test available. The currently used Baermann test is inadequate because of its reliance on patency of infection, and the recovery and distinguishing of dorsal-spined larvae from feces of infected animals. A reliable diagnostic method is urgently needed to diagnose parelaphostrongylosis and to help prevent the translocation of the parasite to other areas of North America and the world. In an effort to develop a serological assay, preparations of excretory-secretory (ES) products, infective third stage larvae and adult worms were assessed for suitability to detect antibodies in the sera of 6 WTD experimentally infected with various doses of *P. tenuis*. Using an indirect ELISA the adult worm preparation yielded unsatisfactory results, but the ES and larval preparations detected anti-*P. tenuis* antibodies early in all infected animals. However, significant cross-reactivity occurred with control sera from deer infected with parasites other than *P. tenuis*. This suggests that unfractionated antigen preparations may not be useful for use in a diagnostic test for parelaphostrongylosis.

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Determination of the activity of nitazoxanide against *Sarcocystis neurona* in cell cultures. DAVID S. LINDSAY,[1]* Y. ZHANG,[1] J.P. DUBEY,[2] AND KATHY PALMA;[3] [1]CENTER FOR MOLECULAR MEDICINE AND INFECTIOUS DISEASES, VA-MD REGIONAL COLLEGE OF VETERINARY MEDICINE, VA-TECH, BLACKSBURG, VA; [2] USDA, ARS, LPSI, PARASITE BIOLOGY LABORATORY, BELTSVILLE, MD; [3] BLUE RIDGE PHARMACEUTICALS, GREENSBORO, NC.

Equine protozoal myeloencephalitis (EPM) is a neuralgic syndrome in horses caused by infection with *Sarcocystis neurona*. Presently, treatment of EPM is with sulfonamides plus trimethoprim and pyrimethamine. Because of the potential for adverse side effects of these agents, safer more economical agents for treatment of EPM are needed. Nitazoxanide (NTZ) is a 5-nitrothiazole that has a broad spectrum of activity against bacterial, protozoa and helminth parasites. Dosages of NTZ greater than 1.0 µg/ml prevented measurable monolayer destruction in a lesion based microassay against developing *S. neurona* merozoites. The IC_{50} for NTZ was 0.52 µg/ml.

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EPIDERMAL GROWTH FACTOR (EGF) INHIBITS INTESTINAL COLONIZATION WITH *CRYPTOSPORIDIUM PARVUM*

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We have recently demonstrated that EGF inhibits colonization of the intestine with pathogenic bacteria. The aim of the study was to determine whether EGF administration could inhibit intestinal colonization by *Cryptosporidium parvum*. Human (CaCo2 and SCBN, a non-transformed human cell line) or bovine (MDBK and NBL-1) intestinal epithelial monolayers grown to confluence on chamber slides were treated with vehicle (control) or 1 µM rhEGF 15 minutes prior to exposure 10^3 *Cryptosporidium parvum* oocysts. After 24 hours, slides were fixed and stained with Diff-Quick and percent epithelial colonization assessed. In a separate study, dexamethazone immunosuppressed Sprague Dawley rats were given saline or oral rhEGF (100 µg/kg). They were challenged 24 hours later with 10^6 *Cryptosporidium parvum.* EGF significantly reduced epithelial colonization by *C. parvum in vitro* and significantly decreased fecal passage of oocysts in infected rats. EGF inhibits colonization with *C. parvum* and reduces fecal excretion of oocysts. EGF is a potential therapeutic agent against *Cryptosporidium parvum.*

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SURVIVAL OF *GIARDIA* CYSTS AND *CRYPTOSPORIDIUM* OOCYSTS IN WATER, SOIL AND CATTLE FECES

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Giardia spp and *Cryptosporidium parvum* are frequently identified in the feces of healthy and diarrhetic cattle. It is believed that agricultural runoff has been responsible for outbreaks of waterborne human giardiasis and cryptosporidiosis. Laboratory studies were conducted to determine the ability of *Giardia* cysts and *Cryptosporidium* oocysts to survive in water, soil and cattle feces. *Giardia* cysts and *Cryptosporidium* oocysts were inoculated into soil (normal and autoclaved), water and fresh cattle feces. Samples were kept at -4, 4 and 25 °C. The total number of cysts/oocysts and number of viable cysts were determined weekly by specific immunofluorescence staining and nuclear staining (propidium iodide). *Giardia* cysts were inactivated by freezing. Cysts were degraded after 2 weeks at 25 °C in soil, feces and water while they remained viable for 5 weeks at 4 °C. In water and soil and at all temperatures, *Cryptosporidium* oocysts were progressively degraded over 4 weeks to 15% of the original inoculant. Viable *Cryptosporidium* oocysts were identified in feces 4 months after inoculation. The optimal temperature for maintaining the number of viable *Giardia* cysts and *Cryptosporidium* oocysts was 4 °C. Proper management of agricultural waste should reduce or eliminate water contamination by these protozoan parasites.

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VIABILITY OF *TRITRICHOMONAS FOETUS* FIELD ISOLATES IN TRANSPORT AND CULTURE MEDIA AT VARIOUS TEMPERATURES.

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Bovine trichomoniasis is a venereal disease of cattle caused by the flagellate protozoan *Tritrichomonas foetus*. The Centre for Animal Parasitology, Saskatoon, performs diagnostic tests (5000 samples/yr) for the detection of *T. foetus* in preputial scrapings from bulls housed in accredited Artificial Insemination Centres. Samples inoculated into transport medium are shipped from all regions of Canada to our laboratory and during transit may be exposed to varying temperatures for different lengths of time. The manufacturer of a commercial transport/culture system for the detection of *T. foetus* recommends that samples should be maintained between 15 - 37°C. In previous studies we have shown that exposure of samples to 4°C reduces the success of culturing *T. foetus* and varies according to the time elapsed between sample collection and culture. To access the effect of other temperatures, known concentrations of *T. foetus* field isolates were inoculated into transport medium and exposed to 10°C or 15°C for up to five days and then cultured in Diamond's medium at 37°C. The effect of these temperatures on the viability of the *T. foetus* isolates and the results of different isolates grown in Diamond's medium, liver infusion broth and InPouch TF will be discussed.

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In vivo stage conversion of *Toxoplasma gondii*. J.P. DUBEY, PARASITE BIOLOGY AND EPIDEMIOLOGY LAB, LPSI, ARS, USDA, BELTSVILLE, MARYLAND 20705

Tachyzoites, bradyzoites, and sporozoites are the three infectious stages of *Toxoplasma gondii*. Humans and animals become infected mainly by ingesting bradyzoites or oocysts. After ingestion, both bradyzoites and sporozoites convert to tachyzoites inside tissues. The conversions of tachyzoites to bradyzoites and bradyzoites to tachyzoites is of biological and clinical significance because bradyzoites are less susceptible to chemotherapy and reactivation of bradyzoites to tachyzoites is considered the cause of fatal toxoplasmosis in AIDS patients. Migration and development of *T. gondii* was studied in mice after oral infection with bradyzoites and sporozoites using histology, immunohistochemistry and bioassays in mice and cats. After ingestion, bradyzoites converted to tachyzoites within 24 hours after infection (HAI) and tachyzoites disseminated to other organs by lymph and blood. Tissue cysts were formed on the 6th day. After ingestion of oocysts, sporozoites converted to tachyzoites by 12 HAI but some sporozoites were in blood by 1 HAI. Tissue cysts were formed by 7 days. Of all the methods tested, bioassay in cats was the most sensitive to study stage conversion.

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Experimental *Cochlosoma anatis* infections in poultry. DAVID S. LINDSAY,[1,2]* C. T. LARSEN,[1,3] ANNE ZAJAC,[2] AND F. WILLIAM PIERSON.[1,3] CENTER FOR MOLECULAR MEDICINE AND INFECTIOUS DISEASES,[1] DEPARTMENT OF BIOMEDICAL SCIENCES AND PATHOBIOLOGY,[2] AND DEPARTMENT OF LARGE ANIMAL CLINICAL SCIENCES,[3] VA-MD REGIONAL COLLEGE OF VETERINARY MEDICINE, VA-TECH, BLACKSBURG, VA

Cochlosoma anatis is a flagellated protozoan parasite of birds. The trophozoites resemble *Giardia lamblia* in that they have a ventral sucking disk. They lack cysts and are related to Trichomonads. We have encountered *C. anatis* in turkeys suffering from enteritis. Experimental oral inoculation of turkey poults with 5 to 10 million trophozoites consistently reproduced infections in recipient poults. Trophozoites were most numerous in the jejunum and ileum but could be observed in the duodenum, colon, feces, and rarely ceca of poults. Four of 6 bobwhite quail and 1 of 8 chickens orally inoculated with 10 to 20 million trophozoites had demonstrable infections. Trophozoites were observed only in the ilea of bobwhite quail and the ceca of the positive chicken. The role of *C. anatis* as a primary pathogen in poultry is currently under investigation.

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IMMUNIZATION OF CHICKENS WITH PLASMID DNA ENCODING RECOMBINANT *EIMERIA ACERVULINA* ANTIGEN VIA JET-GUN INJECTION ELICITS IMMUNITY AGAINST COCCIDIOSIS. M. JENKINS*, P. ALLEN, H. DANFORTH, & P. AUGUSTINE. IMMUNOLOGY & DISEASE RESISTANCE LABORATORY, PARASITE BIOLOGY & EPIDEMIOLOGY LABORATORY, ARS, USDA, BELTSVILLE, MD 20705.

The purpose of the present study was to evaluate direct DNA injection as a way to elicit protective immune responses in chickens against coccidiosis. Preliminary studies showed that tissue expression of luciferase could be detected in one-day-old and one-week-old chickens immunized by jet-gun injection with a plasmid DNA expressing luciferase under control of a CMV promoter. DNAs encoding three different *Eimeria acervulina* antigens (EASZ240, EAMZ250, EASZ22) were then cloned into the pCMV vector and injected either singly or in combination into leg muscle of one-day-old and seven-day-old outbred chickens. The chickens were then challenged at 5 weeks of age with a high dose of *E. acervulina* oocysts and evaluated one week later by protection against weight loss and intestinal lesions associated with coccidiosis. Plasma was collected from all chickens and tested for nitrite + nitrate concentration and for antibodies (Ab) against the recombinant proteins. Chickens immunized with either pEAMZ250 or pEASZ22 plasmid DNA showed nearly complete protection against challenge infection as measured by weight gain compared to control groups immunized with non-recombinant pCMV plasmid. Direct DNA injection elicited antigen-specific Ab, but there did not appear to be any correlation with protective immunity. However, plasmid DNA-injected chickens that were protected against coccidiosis exhibited elevated plasma NO_2 and NO_3 levels. Studies are now underway to improve gene expression whereby lower amounts of recombinant plasmid DNA can be used to elicit immunity against coccidiosis.

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Kinetics of IFN-gamma gene expression in the intestine following *E. acervulina* infection

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Local gene expression of interferon-gamma (IFN-γ) following *E. acervulina* was investigated in the duodenum and caecal tonsils using a quantitative competitive reverse transcriptase PCR (RT-PCR). IFN-γ transcripts were detected in the intestine and caecal tonsils at 2, 4, 6, 8 and 10 days post primary infection (PPI) with *E. acervulina* with a maximum expression at 6 DPI in the duodenum and at 4 DPI in the caeca tonsils. These results indicate that IFN-γ is one of the cytokines induced by *E. acervulina*.

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Evaluation of ConAH11-HgalGP vaccine in Suffolk lambs. *PEÑA, M.T., KABAGAMBE, E.K., MILLER, J.E., SMITH, W. D., BARRAS, S., LI, Y. LOUISIANA STATE UNIVERSITY, BATON ROUGE, LA 70803, MOREDUN RESEARCH INSTITUTE, EDINBURGH, EH 17 7JH, SCOTLAND.

The performance of ConAH11-HgalGP vaccine was evaluated in Suffolk lambs. Twenty two six-month old lambs were randomly assigned into two treatment groups; one was given a vaccine containing Quil A adjuvant and ConAH11-HgalGP antigens (vaccinates), and the other group was given Quil A adjuvant alone (controls). All lambs were exposed to pasture challenge with *Haemonchus contortus* and followed for 12 weeks. Fecal egg counts (FEC) and blood packed cell volume (PCV) were determined every other week for the entire study period. Antibody responses to the ConAH11 and HgalGP antigens were evaluated with ELISA. Although fortnightly FEC of vaccinates and controls were not significantly different ($P>0.05$), the overall mean FEC for vaccinates was lower (7,852 epg) than that of controls (12,075 epg). Also when one lamb considered an outlier, was removed from statistical analysis, overall FEC of vaccinates was 6,279 epg. The antibody responses of vaccinates against ConAH11 and HgalGP antigen were significantly higher than those of controls ($P <0.05$). Lambs of both groups were treated whenever PCV was ≤ 18.There were no significant differences in the number of treatments or mean time of the first treatment between vaccinates and controls. The results of this study showed that ConAH11-HgalGP vaccine stimulates a strong humoral immune response in six-month old lambs. Whether ConAH11-HgalGP vaccine is beneficial in controlling *H. contortus* in lambs under continual natural challenge needs further evaluation.

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Responses to mitogen-stimulation and to immunization with an unrelated antigen of cattle naturally infected with gastrointestinal nematodes after transport to a feedlot .

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Angus-based stocker cattle were kept on parasite infected pastures for 150 days in Fulton MO. Cattle were divided into 3 treatment groups, each of which received a different anthelmintic treatment ranging from no treatment to the administration of an IVOMEC ® Sustained Release Bolus with efficacy for the entire grazing period. Approximately one month before the end of the grazing period one-half of each treatment group (30 animals per treatment) were immunized with 5mg of keyhole limpet hemocyanin (KLH) without adjuvant. The remaining one-half of the animals were given a similar immunization after all animals were sent to a feed lot at Canyon TX one month later. Two weeks after the appropriate immunization, peripheral blood mononuclear cells were collected from the immunized cattle for the assessment of cellular immune responses to KLH and to 2 different concentrations of the mitogen CON A. After an additional 2 weeks, immunized cattle were bled once more for the measurement of anti-KLH IgG1 and IgG2 antibodies, and serum pepsinogen levels. Serum pepsinogen determinations indicated significant differences among all 3 treatment groups at both times tested, with the group receiving no anthelmintic displaying the highest levels of serum pepsinogen. After shipment to the feedlot, all groups showed greatly reduced antibody responses after KLH immunization when compared to the responses of all groups before transport. In addition, the group receiving no anthelmintic had significantly lower responses after CON A stimulation when compared to both anthelmintic treated groups. Differences in grazing cattle before transport were less clear because of significant effects of both the pasture and pasture by treatment interaction.

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Local immune responses induced after primary and challenge infections of cattle with either Ostertagia ostertagi or Haemonchus placei.

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Development of protective immunity to Ostertagia ostertagi is slow and incomplete in spite of strong immunological changes induced at the local site of infection. In contrast Haemonchus placei which also colonizes the abomasum induces rapid and efficient protective immunity in field situations.In the present study differences in local immune responses after either a primary or a challenge infection with O.ostertagi or H. placei were studied. As shown in previous studies no differences in the number of worms developing after a challenge infection with O.ostertagi were noted. Changes in both cytokine and cell surface markers in the local lymph nodes and in the mucosa were in agreement with previously published data. Histological studies of the mucosa showed large increases in the number of eosinophils(EO) and decreases in globular leucocytes (GL). Primary and challenge H.placei infections were clearly different in all parameters when compared to O. ostertagi. Animals with either a primary or challenge infection showed smaller abomasal lymph nodes, but higher number of intra-epithelial (IEL) and lamina propria (LPL) lymphocytes. Histologically the number of EO present in the mucosa decreased after challenge, but the number of GL and mast cells was strongly increased. H.placei primary and challenged animals also showed significantly smaller amounts of IFN-γ mRNA in the LPL, and after challenge there was a downregulation of the inflammatory cytokines IL10, TGF-β and TNF-α.

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EFFECT OF PREVIOUS EXPOSURE ON ESTABLISHMENT OF CATTLE NEMATODES AFTER NATURAL CHALLENGE EXPOSURE ON CONTAMINATED PASTURE.

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While it is generally accepted that exposure of cattle to gastrointestinal nematode infections induces some level of protective immunity upon rechallenge, little is known about magnitude or duration of exposure for such responses. It is commonly held that resistance develops faster and is stronger in intestinal infections when compared to those of the abomasum. The purpose of this study was to assess the effect of a 3-6 month pasture exposure on parasite establishment after a second pasture exposure. Calves grazed on naturally infected pastures in Louisiana at times when: 1) the *Ostertagia* population would be largely inhibited larvae; 2) most *Ostertagia* would develop normally, or 3) over both time periods. All cattle were then housed to preclude further parasite exposure for an additional 6-9 months. At the end of this period all cattle were treated to remove residual worm populations and were placed back on pasture along with age-matched cattle that had been housed for the entire experiment, and with young cattle. Previous exposure resulted in reduced numbers of adult *Ostertagia* and a corresponding increase in the percentage of inhibited larvae, although the total number of worms was not reduced. In addition, worms were significantly smaller and less fecund. In comparison, previous exposure resulted in marked reduction in numbers of *Haemonchus, Cooperia, Trichostrongylus, Oesophagostomum*, and *Trichuris*, although a small percentage of cattle remained susceptible upon challenge. These results indicated that most cattle develop immunity to reinfection with most species after a relatively brief primary exposure. The exception is *Ostertagia*, but this exception is not the result of the site of infection as cattle were able to substantially reduce the numbers of other abomasal nematodes.

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A NOVEL CLASS OF STEROIDS ISOLATED FROM THE DOGFISH SHARK (*SQUALUS ACANTHIAS*) INDUCE A REVERSIBLE SPHEROCYTOSIS IN NORMAL ERYTHROCYTES AND KILL ERYTHROCYTIC STAGES OF *PLASMODIUM FALCIPARUM*. **R.M. KAPLAN*§[1], W. KINNEY‡, & M.A. ZASLOFF‡. §DIVISION OF EXPERIMENTAL THERAPEUTICS, WALTER REED ARMY INSTITUTE OF RESEARCH, WASHINGTON, DC; AND ‡MAGAININ RESEARCH INSTITUTE, MAGAININ PHARMACEUTICALS INC., PLYMOUTH MEETING, PA. [1]PRESENT ADDRESS: UNIVERSITY OF GEORGIA, COLLEGE OF VETERINARY MEDICINE, DEPARTMENT OF MEDICAL MICROBIOLOGY AND PARASITOLOGY, ATHENS, GA.**

A novel class of naturally occurring steroid molecules have been recently isolated from tissues of the common dogfish shark that interact with specific tissues via a receptor-based mechanism. One of these steroids (MSI-1361) inhibits an isoform of the chloride-bicarbonate exchanger AE2 and induces a reversible spherocytosis in erythrocytes. Presently, it is not clear whether this compound also inhibits the erythrocytic Band 3 protein. However, Band 3 is the major protein responsible for providing mechanical stability to the red blood cell (RBC) membrane, and is the primary chloride-bicarbonate exchange molecule of the RBC. Recent *in vitro* experiments demonstrated that the same drug concentrations that induce spherocytosis in RBCs also kill intraerythrocytic stages of *Plasmodium falciparum*. The mechanism of parasite killing appears to be a result of RBC lysis. When *P. falciparum* cultures were examined by microscopy shortly after drug treatment, uninfected RBCs had a spherical shape and smooth surface. However, infected RBCs took a variety of irregular shapes and appeared to lose their structural integrity. After a period of time that varied with drug concentration, all parasites were seen either residing inside a RBC ghost or free in the media. Washing the drug treated RBCs with fresh media caused the RBCs to revert back to biconcave disks. Two semi-synthetic analogs of MSI-1361 also have been tested (MSI-1459, MSI-1566) and show greater stability plus a 10 fold greater activity (IC50s of approximately 3 μg/ml). This newly described group of steroid drugs are water soluble and inexpensive to produce. Since these drugs derive their novel antimalarial activity from effects on the RBC rather than the parasite, these drugs could potentially serve as an alternative therapeutic for multidrug resistant malaria against which resistance could probably not develop.

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Relationship between swine *ASCARIS* infection and visceral larval migrans in humans from pig farming areas in Kyushu, Japan. K. ISHIWATA*[1], Y. NAWA[1], Y. HORII[2], AND F. UCHIYAMA[1], [1]MIYAZAKI MEDICAL COLLEGE, MIYAZAKI 889-16, [2]DEPT. OF VET. INTERNAL MED., FACULTY OF AGRICULTURE, MIYAZAKI UNIV., MIYAZAKI 889-21, JAPAN

Milk spot lesions in pig livers are due mainly to infection with *A. suum*. Even pigs from well managed farms have up to 30% of their livers condemned because of milk spots. However, *A. suum* infection is generally ignored because it does not seriously affect meat production. Recently we found visceral larva migrans (VLM) in humans in Southern Kyushu District where approximately 1/3 of all of Japan's pig production is concentrated. The patients suffered from pneumonitis and/or multiple nodular lesions in the liver with marked eosinophilia. Parasite eggs or worms were not detected in repeated stool examinations from these patients. Their sera reacted strongly against adult *A. suum* antigens by ELISA and Ouchterlony analysis and showed considerable cross reactivity with adult *A. lumbricoides* and *Toxocara canis* antigens. Because *A. lumbricoides* has almost completely been eradicated from Japan and *T. canis* infection of dogs is rare, the patients were diagnosed with VLM due to migrating *A. suum* larvae. Routes of human infection with *A. suum* include ingestion of eggs or raw chicken or calf livers that may contain migrating larvae.

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Migration and development of *Ascaris suum* larvae in *Erythrocebus patas*: Model for visceral larva migrans in humans. J. URBAN*[1], T. RASMUSSEN[2], [3]A. CHEEVER, L. ERIKSEN[2], P. NANSEN[2], AND D. MURRELL[1], [1]IDRL/ARS/USDA, BELTSVILLE, MD 20705 AND [2]DCEP, COPENHAGEN, DENMARK, [3]BRI, ROCKVILLE, MD 20852 USA

Ascaris suum is a known zoonotic agent, but its migration and development in humans is not well characterized. Confinement-reared *E. patas* monkeys were inoculated with *A. suum* eggs to observe clinical effects, migration and development of larvae, and immunity to infection in a non-human primate. Four *E. patas* were inoculated 3 times/wk with 25,000 eggs for a total of 10 inoculations; rested for 2 wks and challenged with 45,000 eggs. A group of 4 naive *E. patas* and 6 piglets were challenged similarly. Two *E. patas* from each group and 3 pigs were necropsied on days 4 and 12 after challenge, and larvae were recovered from the liver, lungs and intestines. Periodic bleeding showed no dramatic changes in blood chemistry, and only 1 of 8 *E. patas* had eosinophilia. Larvae were detected in all locations examined, and some early 5th-stage worms were observed in the ileal/cecal junction of 1 *E. patas*. The kinetics of larval development was delayed in naive *E. patas* compared to pigs, and 94% fewer larvae were recovered. Lesions in the organs were microscopic indicating generally subclinical disease.

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Field efficacy of strategically administered anthelmintics in cow-calf management systems in mountainous areas of Spain.

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Epidemiological studies of gastrointestinal nematode (GI) parasitism in cattle grazing mountaineous areas in Spain suggested that an adequate control of GI parasitism in the area should include a strategic anthelmintic treatment when animals returne to graze hay meadows in the fall combined to the movement to clean pastures. This strategical treatment was considered optimal to reduce pasture larval contamination when simulated with the Paraban mathematical model. To verify the usefulness of the advised treatment in field conditions, a study was performed comparing this treatment to the traditional anthelmintic control in the area, based on one treatment at turnout of animals in spring. The study was carried out from April 95 to May 97. A total of 39 animals were studied, being divided in three groups of 13 animals each. Group A was treated with ivermectin at turnout in spring of both years (95-96), Group B was treated with ivermectin when animals were moved to hay meadows in the fall in both years. Group C remained as untreated control group. Each group grazed together with a herd that followed the same treatment that their respective experimental group. The three herds grazed separated grazing areas. Every two weeks, larval contamination on pasture and egg excretion in the experimental animals were evaluated. The fall treatment (Group B), significantly reduced epg excretion compared to the turnout treatment (Group A) and control untreated group (Group C). Larval contamination was also significantly reduced in both hay meadows and high altitude areas in areas grazed by Group B compared to A and C. The spring treatment significantly reduced epg in the animals compared to Group C, but there was not a significant effect on pasture larval contamination when compared to the control Group C.

This work was supported by project SC94-075.

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MEASUREMENT OF DRUG AND MINERAL INTAKE IN INDIVIDUAL ANIMALS ON RANGE

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Chemotherapeutic agents have been combined with trace mineral/salt mix or protein blocks to control parasitic infections in range cattle. Mineral and drug consumption is based on the intake of the herd but this may not reflect that of the individual animal. Cows and calves were identified individually by a passive radiofrequency device (Allflex) located in the ear. Multiflex radio frequency mineral feeder systems (Growsafe) used to monitor feeder attendance. Feeder load cells integrated to the feeder system measured mineral mix/protein block intake in cows and calves in range cattle or in loafing pens. Medicated (0.468% fenbendazole) or non-medicated mineral mix or protein blocks were provided over a minimum 6 day monitoring period. Daily attendance at feeders, individual daily mineral mix/protein block intake and individual daily intake of drug depended upon the product, position of feeder and time of year. The multiplex radio frequency mineral feeder system and the data it provides will assist in designing range medication programs for cows and calves.

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SURVIVAL AND DEVELOPMENT OF EGGS OF *FASCIOLA HEPATICA* ON PASTURE DURING THE SUMMER IN FLORIDA. **R.M. KAPLAN*[1], B.R. KREITZ, & C.H. COURTNEY. UNIVERSITY OF FLORIDA, COLLEGE OF VETERINARY MEDICINE, DEPARTMENT OF PATHOBIOLOGY, GAINESVILLE, FL 32611. [1]PRESENT ADDRESS: UNIVERSITY OF GEORGIA, COLLEGE OF VETERINARY MEDICINE, DEPARTMENT OF MEDICAL MICROBIOLOGY & PARASITOLOGY, ATHENS, GA 30602.**

Liver fluke control recommendations for beef cattle in the Gulf coast states are based on the premise that flukicidal treatment of cattle in the early autumn kills virtually all flukes, thereby preventing the shedding of fluke eggs onto pasture when snails emerge from summer aestivation. However, recommendations regarding the timing of this autumn treatment do not take into account the possibility of egg refugia on pasture. The purpose of this study was to determine if eggs of *Fasciola hepatica* could survive and develop on pasture during the summer in Florida. Replicate fecal pats containing 100 EPG were deposited onto pasture and 2-gram samples from the pats were collected on days 0, 1, 2, 4, 7, 15, 21, 28 and 35 (experiment 1, 21 June to 26 July); and days 0, 3, 7, 14, 21, 29 and 35 (experiment 2, 09 August to 13 September). Fluke eggs were recovered in water, transferred to 24-well tissue culture plates and placed in darkness at 27°C. Eggs were examined daily until at least 50% of all eggs had hatched or greater than 50% of eggs were dead. Although fecal pat temperatures frequently exceeded 40°C, more than 80% of eggs recovered after 28 days on pasture remained viable in both experiments. In experiment 1, egg development and hatching were inhibited in samples collected on days 4, 7, and 15 requiring 6.5, 3 and 5 more days respectively than controls to hatch. Eggs from samples collected on days 21 and 28 required less time than the control eggs (-4 and -5 days respectively), indicating that development had occurred within the fecal pat. In experiment 2, no inhibition of development was seen. Eggs from samples collected on day 3 hatched in the same amount of time as controls, and beginning with samples collected on day 7, the time required for eggs to hatch decreased with each successive sample. The results of this study demonstrate that eggs of *F. hepatica* can survive and hatch during the hot summer season in Florida. Since flukes acquired in the spring will reach maximum egg production in late summer, timing of autumn treatment with flukicide must take into account the ability of these eggs to survive on pasture for extended periods.

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A Controlled Bridging Study in Equines to Compare the Therapeutic Bioequivalence of 0.5% Fenbendazole Top Dress Pellets and 10% Fenbendazole Suspension Administered Orally

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A controlled test was conducted to demonstrate the efficacy bioequivalence of 0.5% fenbendazole (FBZ) top dress pellets to a 10% FBZ suspension formulation (Panacur® Suspension 10%, Hoechst). Thirty horses harboring naturally-acquired infections were used. Following acclimation, the horses were ranked by descending strongyle egg per gram counts (SEPG) and replicates of three animals were formed. Within each replicate, horses were randomly allocated to receive either FBZ pellets (5 mg/kg), FBZ suspension (5 mg/kg), or placebo pellets on Day 0. The horses were euthanized and necropsied by replicate 7-9 days after treatment. A 10% large intestinal content aliquot was taken at necropsy. Two methods of parasite recovery, including visual inspection of the 10% aliquot and evaluation of a 5% subaliquot via dissecting microscopy, were performed. Pretreatment SEPG were not significantly different ($p > 0.1$). Post-treatment SEPG were reduced by 98-99% in the two FBZ treated groups and were not significantly different ($p > 0.25$). However, post-treatment placebo pellet group SEPG was significantly different ($p < 0.001$). Both post mortem worm counting techniques revealed similar efficacies of both formulations (>95%) against adult small and large strongyles. There were no significant differences in worm burdens between treatment groups, thus demonstrating the bioequivalence of the two formulations. Twenty-two species of small strongyles were recovered. Six species of small strongyles comprised 96% of all the small strongyles recovered: *Cyathostomum coronatum, Cylicocyclus insigne, Cylicostephanus longibursatus, Cylicocyclus brevicapsulatus, Cylicocyclus nassatus*, and *Cylicocyclus catinatum*. Although efficacies determined via both parasite recovery techniques were not significantly different ($p > 0.1$), the number of parasites recovered via visual examination of the 10% aliquot was markedly reduced as compared to dissecting microscopic examination of the 5% subaliquot. Therefore, implementation of both sampling techniques is essential. No adverse reactions were detected in this study.

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Effectiveness of Moxidectin for Benzimidazole and Pyrantel Resistant Cyathostomes in Horses

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Three trials were conducted at 2 sites in Ontario August-December 1997. For each trial, equids were randomly assigned to treatment groups. At Site 1, 9 thoroughbred yearlings which had been fed daily pyrantel tartrate (Strongid C) for 60 days were in 3 groups of 3 yearlings: (1) continued on pyrantel tartrate daily, (2) one dose of pyrantel pamoate (Strongid P), (3) one dose of moxidectin (Quest Gel). Subsequently, 12 mares were in 2 groups of 6 mares: (1) one dose of pyrantel pamoate (Strongid P), (3) one dose of moxidectin (Quest Gel). At Site 2, 20 standardbred mares were in 2 groups of 10 mares: (1) one dose of fenbendazole (Panacur), (2) one dose of moxidectin (Quest Gel). Fecal samples were taken from each equid pre-treatment and 10-14 days post-treatment for parasite epgs. Feacl samples were taken from each equid and pooled by treatment group for coproculture.

Pre and post treatment arithmetic mean epgs were as follows: Yearlings - Strongid C, 24.5 and 44.6, Strongid, P 13.9 and 17.1, Quest, 21.7 and 0; Thoroughbred mares - Strongid P, 22.9 and 9.7, Quest, 17.1 and 0; Standardbred mares - Panacur, 167.3 and 82.6, Quest, 163.3 and 0. Cyathostome larvae were recovered from coproculture from pretreatment and post-treatment cultures except post-treatment cultures for equids treated with Quest.

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RECENT ADVANCES IN THE IDENTIFICATION AND CLASSIFICATION OF SMALL STRONGYLES OF HORSES J. R. LICHTENFELS (*), V. A. KHARCHENKO, R. C. KRECEK AND L. M.. GIBBONS. AGRICULTURAL RESEARCH SERVICE, USDA, BELTSVILLE, MD 20705, USA; I. I. SCHMALHAUSEN INSTITUTE OF ZOOLOGY, KIEV 30, GSP 252601, UKRAINE; UNIVERSITY OF PRETORIA, PRIVATE BAG XO4, 0110 ONDERSTEPOORT, REPUBLIC OF SOUTH AFRICA; THE ROYAL VETERINARY COLLEGE, NORTH MYMMS, HATFIELD AL9 7TA, UNITED KINGDOM.

Research on the small strongyles is high because of: 1) a new disease syndrome in which larvae in the wall of the gut may cause severe colitis or death; 2) resistance by the nematodes to anthelmintics; and, 3) prospects for biocontrol using soil fungi. Identification keys for adult nematodes have not been revised recently, most larval stages are poorly known, and eggs are impossible to distinguish. Several laboratories are developing species-specific DNA probes for these pathogens. The results of an international effort to prepare a recommended list of scientific names for the small strongyles (Nematoda: Strongyloidea: Cyathostominea) of equids are reported. Fifty-one valid species are recognized and classified in 13 genera, including Cyathostomum, Coronocyclus, Cylicodontophorus, Cylicocyclus, Cylicostephanus, Skrjabinodentus, Tridentoinfundibulum, Petrovinema, Poteriostomum, Parapoteriostomum, Hsiungia, Cylindropharynx, and Caballonema. In addition, 42 other species-level names are listed as synonyms, as species inquirenda (10), or nomina nuda (1).

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CHARACTERIZATION OF *GIARDIA* RECOVERED FROM A HORSE
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Giardia was recovered from the feces of a clinically healthy horse although animals in the stable were reported to have had diarrhea. The cysts were inoculated into a protozoan-free Gerbils and large numbers of fecal cysts and intestinal trophozoites were recovered. The trophozoites were successfully cultured in TYI-S-33 media. The *Giardia* recovered from the horse were morphologically indistinguishable from that recovered from humans following examination with light microscopy and scanning electron microscopy. SDS page electrophoresis was performed on the trophozoites from the horse and other mammals. There were no major differences between the horse isolate from other mammals. Western blots were also performed on the horse isolate, human isolates, a sheep isolate and a dog isolate using the serum of the infected horse. The horse serum recognized similar *Giardia* antigens. Currently 16 S ribosomal DNA sequencing is being conducted to detect differences between the horse isolate and isolates from other species. *Giardia* from horses may present a potential zoonotic threat to humans in contact with infected horses.

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Cytokine gene expression to *Strongylus vulgaris* infection in immune and nonimmune ponies.
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Ponies are protected from infection with *S. vulgaris* by vaccination with irradiated L3. Some immune responses associated with this protection are an antibody mediated-activated eosinophil killing of L3 in vitro, an anamnestic eosinophilia and the production of eosinophil chemotactic factor by antigen stimulation of lymphocytes. Gene expression of IL-2, IL-4, IL-5, IL-10 and IFN-gamma was quantitatively measured by a RT-QPCR method following challenge infection of vaccinated and naive ponies. RNA for this purpose was collected from peripheral blood mononuclear cells (PBMC) and colonic lymph node cells (CLNC) prior to and during the early course of infection. RNA was collected from cells immediately after removal and following in vitro stimulation with antigen. CLNC were collected by sequential surgeries at days -4,4,and 9 post infection. Prior to challenge vaccinates produced more IL-4 and IL-5 than naive ponies. Both CLNC and PBMC exhibited a Type 2 cytokine response following challenge infection in both vaccinates and naive ponies. However, this response appeared earlier in vaccinates than in naive animals. This response was also seen first in the CLNC. These cytokine data support previous observations suggesting that a type 2 cytokine response is involved in the protective immunity to these equine nematodes.

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DANIEL ELMER SALMON--A PARASITOLOGIST IN HIS OWN RIGHT.
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A century ago Daniel Elmer Salmon (1850-1914), President of the United States Veterinary Medical Association, fostered the proposition to change the USVMA's name to the AVMA. D. E. Salmon, who in 1876 received the first Doctor of Veterinary Medicine Degree to be awarded by a university in the United States, is one of the towering figures in the world of veterinary sciences. He was a veterinary practitioner, a bacteriologist and a parasitologist. Also, he was an excellent manager, in the modern context of the word. In 1884, at 34 years of age Salmon was appointed the first chief of the Bureau of Animal Industry. In 1888 he directed T. Smith and F. L. Kilborne to make a systematic investigation of Texas cattle fever that culminated with the publication of a classic report issued in 1893 on the nature, causation, and prevention of the disease. He also directed investigations on sheep parasites, particularly on sheep scab. Finally in his last years, while serving as Director of the National Veterinary School in Montevideo, Uruguay, he spent considerable time teaching parasitology to the students of that school disseminating the knowledge acquired during his tenure at the BAI.

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Veterinary Parasitology Web Site
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The Veterinary Parasitology Web Site contains information about the major parasites of domestic animals in HTML format and is located on the Internet at the URL http://www.missouri.edu/~vmicrorc/vp556.html. It is intended for use by veterinary practitioners, their staff, and veterinary students as a method of obtaining information about veterinary parasites, their life cycles, their significance to the host animal and owner, and means of treatment and control. Information is provided on approximately 300 individual or groups of parasites, a listing of parasite taxonomy, charts containing information about the major parasites of specific animal species, and information about antiparasitic agents. In addition, there is a section that contains information about the diagnostic procedures used to isolate parasites, approximately 400 images for use in identifying isolated parasites in their various life stages, and essays explaining topics not adequately covered by the outline format of individual parasite data. A glossary is also included for use in understanding the terminology found in this web site, and hyperlinks connect information from the various sections contained in this web site so that relevant information may be easily and rapidly accessed.

By utilizing the Internet, new information may be quickly and easily added, then rapidly made available to interested parties. It is our hope that making this information easily available to veterinarians will help practitioners and their staff understand more about the major parasites of domestic animals and aid the treatment of their clients' animals.

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Computer-Aided Learning – A tool for teaching or technological "overkill"?
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Computer-aided learning includes multi-faceted tools that open up the possibilities of bringing significant changes to the way we teach veterinary students. The advantages and disadvantages of several "currently-in-vogue" teaching tools will be discussed. A current project to construct an on-line book, "Parasites and Parasitic Diseases of Domestic Animals", will be described and demonstrated. This project will integrate text and images and will be accessible via the world wide web.

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VIDEO "LIFE CYCLE OF *Eimeria tenella*"

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Eimeria tenella causes cecal coccidiosis in the domestic fowl. For the first time it has been possible to show the complete life cycle of this coccidian species. By cultivation in primary chicken kidney cells, the endogenous phase is demonstrated. The invasion of sporozoites into the host cells and their further development are shown as well as the multiple asexual reproduction (schizogony) and the maturation of female and male gamonts to gametes (gamogony). This is followed by a presentation of the exogenous phase, the sporogony of oocysts.

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HISTOLOGICAL EVALUATION OF EFFECT OF NEEM LEAF EXTRACT ON *HAEMONCHUS CONTORTUS* : *IN VITRO* STUDY

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The prevalence of *Haemonchus contortus* in sheep and goat is very high in Patiala region. As anthelminthic resistance against commonly used modern drugs is common in parasitic nematodes, an *in vitro* study was undertaken to assess the efficacy of an anciently used formulation of neem *(Azadirachta indica)* on adult *Haemonchus contortus*. The aqueous leaf extract was prepared in 1:5 ratio and this was taken as stock solution (S). The experimental solution concentrations were prepared from the stock solution as S/2, S/4, S/10 and S/20. The adult worms were maintained in four groups in tyrode solution and the extract and tyrode solution was taken in the ratio of 1:1 at each dose. Simultaneously, one group of worms in tyrode solution alone served as control. The motility and mortality of all experimental groups and control was noted at regular intervals. After the death, the worms of all the groups were fixed and processessed for histological studies. The plant extract secreened in, *in vitro* conditions depict that the treatment of the extract on the parasite gives good results and is effective for the control of this parasitic nematode.

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Efficacy of *Duddingtonia flagrans* in reducing infective equine cyathostome L3 on pasture in southern Louisiana.
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Feeding of the nematophagous fungi *Duddingtonia flagrans* spores has been demonstrated to effectively reduce pasture burdens of equine strongyle L3 in cold temperate climates. The objective of the current investigation was to determine the effectiveness of this procedure in the subtropical climate of southern Louisiana. Fecal pats were constructed by mixing feces obtained from a parasite-free horse fed *D.flagrans*, at a dose of 1.9 x 10^6 spores/kg, with feces from a parasitized horse containing cyathostome eggs. Control pats contained feces from a parasite-free horse mixed with feces containing cyathostome eggs. The fecal pats were set on pasture, in replicates of 6, at 4 week intervals from March 1997 until January 1998. Comparisons of L3 recoveries from non-treated control pats with non-treated cultures in the laboratory indicated that L3 survival on pasture was reduced during the months of May, June, July and August. Efficacy of fungi was determined by L3 recovery from grass surrounding the fecal pats of treated and control groups. *Duddingtonia flagrans* effectively reduced the L3 larval burdens during all seasons of the year. The data collected show an average percent reduction of 77%, with a maximum of 99.5% and a minimum of 45.5%.

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Entomopathogenic Nematodes as Control Agents of Developmental Stages of the Black-Legged Tick, Ixodes scapularis.
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Thirteen species or strains of entomopathogenic nematodes of the genera Steinernema and Heterorhabditis were tested in vitro against unfed and engorged larvae, nymphs, and adults of the black-legged tick, Ixodes scapularis. Nematodes were pathogenic to engorged female ticks, but not to unfed or engorged larvae, nymphs, males, and unfed females. S. riobravis (355) and H. megidis (M145) killed ticks most rapidly, with mean day of death post infection of 2.5 and 3.5 days, respectively. However, all strains were lethal to infected ticks within 7.5 days. Development of juveniles and reproduction of nematodes did not occur inside the tick cadavers, since no infective juveniles (IJs) emerged from cadavers after 40 days, and no nematode life cycle stages other than the primary IJs could be isolated from cadavers. Egg masses were produced by 4 of 234 nematode infected, engorged females. Egg masses produced were not significantly smaller than masses produced by control ticks, however, only one of the 4 egg masses hatched. Entomopathogenic nematodes may be useful as an alternative management method for I. scapularis populations, and may be more acceptable than acaricidal chemicals for use in infested areas.

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LARVICIDAL ACTIVITY OF CRYSTAL TOXIN OF BACILLUS THURINGIENSIS TO HAEMONCHUS CONTORTUS-fourth-STAGE LARVAE. YAO BAOAN, WANG XIANG, XIA XUESHAN, ZHAO JINLONG AND YU ZIAIU, HUAZHONG AGRICULTURAL UNIVERSITY, WUHAN 430079 P.R.OF CHINA

The fourth-stage larvae (L4) of the ruminant parasite Haemonchus contortus were obtained by third-stage larvae with 0.2% sodium hypochlorous acid, 37°C, 25 rpm shaking, 25min, centrifuged, washed with sterilized PBS and took sheath out through screen. L_4 were placed in 70% calf serum, 30% RPMI1640 and 10mg/ml yeast infusion medium. The crystal soluble toxin spores of the Bacillus thuringiensis(Bt) strain YBT-1953 was prepared as follows: To culture Bt with broth medium in shaking oven at 30°C, 200rpm for 48h. The spernatant was decamted after centrifugation, the sediment was washed by 1 M Nacl and distilled water respectively. The crude crystal were resolved by 0.5% NaOH, collected the supernatant after centrifugation. To leak the Na^+, OH^- out using leaked bag with distilled water. About 100 larvae with 1 ml culture medium and different quantity of crystal toxin of Bt were placed in monoclonal plate at 38°C in 5% CO_2 incubator for 72h, the results shown treatment of L_4 with 278 ug total protein/ml of Bt toxin yielded 100% mortality. (This research supported by China National Nature Science Fund)

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Distribution of endectocide compounds to target tissues in cattle. A.LIFSCHITZ* (1), G.VIRKEL(1), J.SUTRA(2), P.GALTIER(2), M.ALVINERIE(2), C.LANUSSE(1). AREA FARMACOLOGIA, FACULTAD de CIENCIAS VETERINARIAS, UNIVERSIDAD NACIONAL del CENTRO, TANDIL, ARGENTINA (1). INRA, TOULOUSE, FRANCE (2).

This study is part of the experiments currently undergoing to understand the relationship between plasma disposition, distribution to target tissues and the persistence of the antiparasitic activity of endectocide compounds. The comparative pattern of distribution of these molecules to target tissues in cattle was investigated. Ivermectin (IVM), moxidectin (MXD) and doramectin (DRM) were subcutaneously administered to Holstein calves (120-140 kg) using available formulations. Two animals/group were sacrificed at 1, 4, 8, 18, 28, 38 and 48 days post-treatment. Plasma, abomasal and intestinal mucosas/contents, bile, feces and skin samples were obtained, processed and analyzed by HPLC using fluorescence detection. The three molecules were extensively distributed to all target tissues. MXD peak concentrations in mucosas, bile, skin and feces were obtained at 1-day post-treatment, which correlates with the rapid MXD absorption from the injection site. IVM and DRM peak concentrations in those tissues were achieved at 4-days post-administration. Tissue availability for the three compounds was greater than that in plasma. Drug concentrations in abomasal (50-fold) and intestinal (2.5-fold) mucosas were greater than those found in their respective fluids. DRM and MXD concentrations in abomasal/intestinal mucosas and skin resulted >1 ng/g at 28 days post-treatment Total drug availability (expressed as AUC) for DRM and IVM were greater than that found for MXD in abomasal mucosa (DRM=1292, IVM=959, MXD=371 ng.d/g), gut mucosa (942, 736 and 228 ng.d/g) and skin (657, 412, 387 ng.d/g, respectively). However, MXD concentrations at 38 and 48 days were higher than those of DRM and IVM in most of the tissues, particularly in bile and feces where MXD residence times were significantly longer, reflecting the prolonged plasma persistence of this compound. Unidentified metabolites of the three compounds were detected in all the tissues analyzed.

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FIELD AND CONTROL TRIAL DETERMINATIONS OF MOXIDECTIN EFFECTIVENESS IN THE TREATMENT OF NATURALLY ACQUIRED, BOVINE NEMATODOSIS. T.A. YAZWINSKI*[1], C. TUCKER[1], R.M. CLEALE[2] AND G.T. WANG[2]. [1]DEPT. OF ANIMAL SCIENCE, UNIVERSITY OF ARKANSAS, FAYETTEVILLE, AR, 72701; [2]FORT DODGE ANIMAL HEALTH, PRINCETON, NJ.

Two studies were recently performed at the University of Arkansas to further establish the anthelmintic effectiveness of moxidectin (CYDECTIN® Fort Dodge Animal Health) in cattle. In the initial study, a field trial was conducted to evaluate the final, commercial formulation of moxidectin 0.5% pour-on under "real life" conditions, when delivered at the effective rate of 0.5 mg/kg BW. One hundred and fifty stocker calves of mixed beef breeding were ranked by pre-treatment EPG counts, blocked in accordance with rank, randomly assigned treatment within block, treated according to assignment on day 0 (investigators blinded to treatment throughout the study), and pastured by treatment group until day 21. Fecal samples were drawn for EPG determinations on trial days -12, -7, 14 and 21. In contrasting geometric mean EPG counts (strongylate) on day -7 to counts on days 14 and 21, control animal counts changed +1.9% and -22.3%, respectively. For the same comparisons, animals treated with moxidectin had EPG counts changed by -99.3 and -99.0%, respectively. Similar results were attained with *Nematodirus* EPG counts, with reductions for moxidectin-treated calves ≥ 90%. In the second study (control), the efficacies of moxidectin, delivered by subcutaneous injection at the rates of 0.2 and 0.3 mg/kg BW were confirmed in naturally infected cattle. For *Ostertagia lyrata*, *O ostertagi*, *Ostertagia* spp. EL4 and LL4, *Trichostrongylus axei*, *Cooperia oncophora*, *C punctata*, *C surnabada*, *Cooperia* spp. L4, *Nematodirus helvetianus* (adults and L4) and *Oesophagostomum radiatum*, percent reductions of geometric means for parasites recovered at necropsy ranged from 95.5-100.0 and 96.4-100.0 from control levels for moxidectin as delivered at 0.2 and 0.3 mg/kg BW, respectively.

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Comparison of Ivermectin Topical vs. a Combination of Fenbendazole, Permethrin and Fenthion in Feedlot Calves. P.T. GUICHON[1*], C.W. BOOKER[1], G.K. JIM[1], O. C. SCHUNICHT[1], J.R. BROWN[2]. [1]FEEDLOT HEALTH MANAGEMENT SERVICES, OKOTOKS, ALBERTA, CANADA [2]MERIAL LIMITED, ST. LOUIS, MO., U.S.A.

The study was designed to compare the effect of treating animals with topical ivermectin at entry into the feedlot to treatment with fenbendazole, permethrin and fenthion on productivity, morbidity, mortality and carcass variables. Fourteen thousand one hundred and eighty-four crossbred beef calves were randomly allocated at the time of processing to the treatments such that there were approximately the same number of animals in each pen of a pen replicate: Group 1: IVOMEC® Pour-On for Cattle at 500 mcg ivermectin/kg, applied topically along the dorsal midline. Group 2: Safe-Guard 10% Oral Suspension at 5 mg fenbendazole/kg, administered orally; Expar (permethrin) Pour-On Insecticide at a dose of 100 ml per animal; and Spotton (fenthion) at a dose of 12 ml per calf. A total of 15 pen replicates were formed. Each pen contained 306 to 672 animals, at similar stocking rates for the pens in a replicate. The animals were given routine vaccinations and other treatments, and were fed standard feedlot rations *ad libitum*. The animals were weighed individually at entry to the feedlot and in groups when ready for slaughter. Hot carcass weight, yield grade and quality grade were obtained for each animal at slaughter. The animals treated with IVOMEC Pour-On were significantly heavier when sent to slaughter (+20.5 lb.) had significantly improved average daily gain (4.13%) and feed efficiency (3.92%) during the feeding period as compared to the conventionally treated control animals ($p < 0.01$). Animals treated with IVOMEC Pour-On had significantly heavier carcass weights (+9.3 lb.) and significantly larger numbers of carcasses grading Quality Grade Prime or Choice (+9.3%) as compared to the conventionally treated control animals ($p < 0.01$). Geometric mean fecal egg counts for the two groups at entry to the feedlot were similar (18.8 eggs/5 g of feces for controls and 22.6 eggs/5g of feces for the ivermectin group). ®IVOMEC is a registered trademark of Merial.

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Persistent Efficacy of Doramectin Pour-On Solution Against Artificially-Induced Infections of *Dictyocaulus viviparus* in Cattle. B. STROMBERG*, B. WOODWARD, AND G. AVERBECK, UNIVERSITY OF MINNESOTA, ST. PAUL, MN, L. SMITH, RESEARCH AND DEVELOPMENT, INC. LODI, WI, T. SKOGERBOE AND J. CUNNINGHAM, PFIZER ANIMAL HEALTH GROUP, LEE'S SUMMIT, MO.

Two studies were conducted to evaluate the persistent efficacy of doramectin pour-on solution, at a dose rate of 500 µg/kg (1 mL/10 kg), against artificially induced infections of *Dictyocaulus viviparus*. In each study, 42 calves, treated on Day –15 or Day –14 with fenbendazole orally at 10 mg/kg to clear any existing *D. viviparus* infections, exhibited no *D. viviparus* larval counts on Baermann examination (Day 0). On Day 0, the animals were randomly allocated to one of four groups of ten animals each (T1, T2, T3, and T4) or as one of the two larval viability monitor animals. On Day 0, animals in Groups T1 and T2 were treated with saline (1 mL/10 kg) or doramectin, respectively. Treatment Groups T3 and T4 were treated with doramectin on Days 7 and 14, respectively. All treatment administrations were poured down the midline of the back. On Day 28 through Day 42, approximately 100 infective *D. viviparus* larvae were given daily by oral gavage to each animal in Groups T1-T4. On Day 42, the two larval viability monitor animals were given approximately 3,000 infective *D. viviparus* larvae. Five animals from each treatment group (T1-T4) and one larval viability monitor were slaughtered on each of Days 56 and 57 for determining *D. viviparus* burdens. Efficacy was calculated based on the percentage reduction in *D. viviparus* burdens of doramectin-treated calves compared to saline-treated calves. Based on geometric means. the persistent efficacy of doramectin pour-on against *D. viviparus* at persistence intervals of 28, 35, and 42 days was 92.7, 70.1, and 50.5%, respectively.

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PRESISTENT EFFICACY OF DORAMECTIN AGAINST *HAEMONCHUS PLACEI* INFECTIONS IN CATTLE. T.A. Yazwinski*[1], C. Tucker[1], Z. Johnson, and D. Walstrom[2]. [1]Department of Animal Science, University of Arkansas, Fayetteville, AR 72701. [2]Pfizer Animal Health, Pfizer Inc, Lee's Summit, MO 64081

The persistent efficacy of doramectin injectable solution, administered subcutaneously at a dosage of 200 µg kg^{-1}, was evaluated in calves against artificially induced infections of *Haemonchus placei*. Initially, 40 male castrate Holstein calves 2 to 6 months of age were placed in housing which precluded extraneous infections and cleansed of existing nematodiasis with fenbendazole (SAFEGUARD® Hoechst) drench (10 mg kg^{-1}). On day 0, ten calves received saline subcutaneous injection (T1) and ten calves (T2) received doramectin. On study days 7 to 14, additional groups of 10 calves were treated with doramectin; groups T3 and T4, respectively. On each day from day 14 to 28, each calf was orally administered approximately 300 *H. placei* L3; larvae which were obtained via coproculture from a recent, mono-specific infection. All calves were slaughtered on days 42 and 43. All nematodes from 2%, abomasal aliquots were recovered, identified and counted for each trial animal. Percent efficacies were determined from geometric means. In comparison to control calf burdens at necropsy, efficacies (% reductions) for *H. placei* mature adults, L5 adults and L4 larvae were 99.7, 85.2 and 64.8 (T2), 99.8, 93.5 and 62.2 (T3) and 100.0, 94.4 and 60.5 (T4), respectively. Overall % reduction were 94.6, 94.1 and 95.4 for treatment groups T2 (4 weeks post treatment), T3 (3 weeks pt) and T4 (2 weeks pt), respectively.

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EFFICACY AND PRODUCTIVITY RESPONSES OF DECTOMAX®-TREATED STOCKER CALVES IN ALABAMA. R.E. BLAYLOCK, AUBURN UNIVERSITY, DECATUR, AL AND J.P. POLLREISZ AND R. S. REW*, PFIZER ANIMAL HEALTH, EXTON, PA

Two trials were conducted on stocker calves in Alabama to determine the efficacy and productivity responses following treatment with Dectomax injected at 200 mcg/kg or Ivomec®Plus injected at 200 mcg/kg in comparison to an untreated control. The studies were conducted to match the normal site management practices of buying cattle, backgrounding them on pasture for 60 days, then sending them to a feedlot. The length of the trial allowed for a test of efficacy and productivity responses primarily from larvae on the pasture at time of trial initiation without confounding the trial with a new generation of larvae. Therefore, all animals were placed on a common pasture after treatment of 2 of the 3 groups. 150 calves were randomly allocated to 1 of 3 treatment groups. Fecal samples were taken for egg count analysis, but the counts were not used in the allocation process. Animals were sampled for fecal egg counts and weights were taken at trial initiation, 30 days into the trial, and at trial completion (Day 60). Data from the trials were analyzed individually and in a cross-trial analysis. Mean geometric fecal egg counts were reduced to < 6 epg by treatment as measured by Day 30 egg counts in both trial and did not exceed 7 epg at Day 60 of the studies. Cross trial analysis of the weight gain for the two studies indicated that untreated calves gained an average of 123.6 lbs, Ivomec Plus-treated calves gained 135.5 lbs, and Dectomax-treated calves gained 143.7 lbs over 60 days. Comparison of treated versus non-treated weight gain means demonstrated a significant ($p < 0.05$) difference for treatment with either product. Comparison of Dectomax-treated versus Ivomec Plus-treated weight gains demonstrated a non-significant difference at p=0.054. Dectomax is a registered trademark of Pfizer, Inc. Ivomec Plus is a registered trademark of Merck & Co., Inc.

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The Prevalence of Gastrointestinal Nematode Parasites in Well Cared for Pet Dogs in the East Coast of the U.S.A. GARY SMITH* & GERHARD SCHAD, UNIVERSITY OF PENNSYLVANIA SCHOOL OF VETERINARY MEDICINE, & JORGE GUERRERO, MERIAL LIMITED.

Previous studies of prevalence of canine parasites based on fecal flotation of pound dog feces reported a frequency of 19.1% for hookworms, 14.5% for roundworms and 14.3% for whipworms. The present study was conducted to evaluate the prevalence of gastrointestinal nematode parasite infections in well cared for dogs in the east coast of the USA. In this study, 105 small animal clinics in the Mid Atlantic states were approached. Each clinic was asked to provide fecal samples obtained directly from dogs presented at the clinic for any reason. Each clinic was provided with enough plastic containers for 20 individual samples and asked to collect all samples within two or three contiguous days. The containers were either collected directly from the clinic or shipped overnight packed in ice gels in insulated cartons and were processed by zinc sulphate flotation. Nineteen hundred and forty samples were processed. The roundworm, *Toxocara canis,* was the most prevalent parasite (3.0% overall prevalence). Twelve percent of all dogs 6 months of age or younger were infected with this parasite. Whipworms (*Trichuris vulpis)* and hookworms (*Ancylostoma caninum* and *Uncinaria stenocephala*) followed with prevalence of 1.6 and 1.5% respectively. The prevalence of hookworms was higher in the younger age classes of dogs (3.7% of all dogs 6 months old or less were infected with *Ancylostoma caninum*). Prevalence of whipworms was found to be equivalent among dogs receiving monthly broad spectrum heartworm preventives. To obtain clinical impressions of parasite prevalence, surveys were mailed to 1,141 AAHA registered veterinary clinics in 18 states on the east coast (Maine to Florida). Four hundred and forty one usable responses (39% response rate) were received. All questionnaire items gave the following rank order: roundworms (most common), hookworms, whipworms, heartworm (least common) with *Strongyloides stercoralis* and *Oslerus osleri* being only rarely reported.

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THE PREVALENCE OF ENDOPARASITES OF DOGS AND CATS IN SHELTERS AND THE EFFECT OF ANTHELMINTIC PROTOCOLS. MARJORIE O'BRIEN AND THOMAS J. NOLAN*, UNIVERSITY OF PENNSYLVANIA SCHOOL OF VETERINARY MEDICINE, PHILADELPHIA, PA.

Fecal samples from dogs and cats housed in 4 local shelters were collected weekly during the summer of 1997. The four shelters differed in how they treated animals with regard to nematode parasites. Shelter #1 gave each animal pyrantal pamoate upon arrival, ran a fecal exam as soon as possible and treated all infected animals with ivermectin. Shelter #2 gave no treatment, shelter #3 gave pyrantal pamoate to any animal with diarrhea or a positive fecal exam, and shelter #4 gave pyrantal pamoate to all arriving animals. In general shelter #1 had the lowest prevalence of nematode parasites and shelter #2 had the highest. Shelter #1 also provided blood samples from 97 dogs. These samples were screened for heartworm, *Ehrlichia canis, Rickettsia rickettsii*, and *Borrelia burgdorferi*. Antibodies to *R. rickettsii* were detected in 40.6% of the dogs and 25.8% had antibodies to *B. burgdorferi*. Antibodies to *E. canis* were seen in 8.2% of these dogs and 7.2% of the dogs had heartworm antigen in their blood. *E. canis* and *R. rickettsii* occurred together in dogs more often than expected by chance alone.

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Studies on filariasis of dogs in Los Angeles County, California. Local vectors of *Dirofilaria immitis*. J.H. THEIS* SCHOOL OF MEDICINE, UNIVERSITY OF CALIFORNIA, DAVIS, DAVIS, CA, 95616, J.G. KOVALTCHOUK AND R. SAVISKAS, LOS ANGELES WEST VECTOR CONTROL DISTRICT, 6750 CENTINELLA AVE., LOS ANGELES, CA, 90230 AND K.K. FUJIOKA, SAN GABRIEL VALLEY MOSQUITO AND VECTOR CONTROL DISTRICT, 1145 N. AZUSA CANYON ROAD, WEST COVINA, CA, 91790.

Adults of four species of mosquitoes collected as larvae from breeding sites in or near Los Angeles County were tested for their willingness to feed on dogs, the level of microfilaremia necessary for fed mosquitoes to ingest microfilaria and the ability of mosquitoes to support development of *D. immitis* to infective L_3 stage. *Aedes taeniorhynchus, Culex tarsalis, Culex quinquefasciatus,* and *Culiseta incidens* were tested. Only *A. taeniorhynchus* and *Cs. incidens* readily fed on the dogs. Only *Cs. incidens* supported development to the L_3 stage showing a vector efficiency of 16%. Microfilaremias of 14/20 cmm of blood did not result in the ingestion of any larvae while microfilaremias of 29, 48, and 95 microfilariae/20 cmm of blood did. Microfilaremias of 117/20 cmm of blood were not tolerated by *Cs. incidens*, all fed mosquitoes dying within 6 days post feeding, and having extensive larval infections in their Malpighian tubules.

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Studies on filariasis of dogs in Los Angeles County, California, July 1, 1996 through August 31, 1997. J.H. THEIS* SCHOOL OF MEDICINE, UNIVERSITY OF CALIFORNIA, DAVIS, CA, 95616 AND F. STEVENS, VETSOFT, DAVIS, CA, 95616.

A total of 3,559 blood samples were examined over a 14 month period by an ELISA adult antigen test and a polycarbonate filter-acid phosphatase stain for the detection and identification of *Dirofilaria immitis* and *Dipetalonema reconditum*. Each dog had the following data recorded: domicile address, management, travel history, prophylaxis status, age, gender, breed. Forty seven percent of the dogs examined (1,673) were males (M) and fifty three percent (1,886) were females (F). Five dogs (2M and 3F) were found infected with *D. immitis* (1.4/1000), and 31 dogs (19M, 12F) were infected with *Dipetalonema reconditum* (8.7/1000). Three of the five dogs infected with *D. immitis* had not traveled out of Los Angeles County. Only 38% of all dogs examined had not traveled out of Los Angeles County. Prevalence among non-travel dogs examined (3/1,352) is 2.2/1000, while prevalence in dogs with a travel history is 2/2207 or 0.9/1000. Nineteen of 31 infections with *Dipetalonema reconditum* (61%) were males while males comprised only 47% of the total dogs examined. Distribution of cases of *D. reconditum* are geographically confined to the western facing slopes of the Santa Monica mountains or direct coastal areas of Los Angeles County. No cases were discovered in dogs residing in the San Fernando Valley of Los Angeles County.

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ANGIOSTRONGYLUS VASORUM INFECTION IN DOGS IN NEWFOUNDLAND, CANADA.

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ATLANTIC VETERINARY COLLEGE, CHARLOTTETOWN, P.E.I.; DEPT. FOREST. & AGRIC., ST. JOHN'S, NFLD; SUNRISE ANIMAL HOSPITAL, MOUNT PEARL, NFLD.

Angiostrongylus vasorum, is a metastrongylid parasite infecting the pulmonary arteries of wild and domestic canids. It has been considered cosmopolitan in its distribution excepting North America. In August, 1996, a fecal sample from a 5 year-old male beagle from Mount Pearl, Nfld was examined. The dog had a history of chronic cough of 2.5 months duration. First-stage larvae of *Angiostrongylus vasorum* and *Crenosoma vulpis* were recovered. Fecal samples from two additional dogs in the household were examined and found to be positive (one had *C. vulpis*, the other had *A. vasorum)*. The dogs were treated with 2 doses of ivermectin (200 mg/kg - 2 weeks apart). The first dog developed post-treatment ascites and dyspnea and was placed on a bronchodilator (Theo-dur) and a diuretic (Lasix). Fecal examination 2 weeks post-treatment was still positive for *A. vasorum*. The dog was treated with a second course of ivermectin (2 doses - 2 weeks apart). Clinical signs resolved subsequent fecal examinations were negative. Since these animals were detected, a further 6 cases have been diagnosed, all confined to the eastern Avalon Peninsula area of Newfoundland.

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ENVIRONMENTAL CONTAMINATION BY PUPPIES INFECTED WITH *TOXOCARA CANIS*. KEVIN R. KAZACOS, DEPARTMENT OF VETERINARY PATHOBIOLOGY, PURDUE UNIVERSITY, WEST LAFAYETTE, IN 47907.

The objective of this study was to examine the extent of environmental contamination by puppies infected with *Toxocara canis*. Two 6-week-old, mixed breed puppies infected from birth with *T. canis* were allowed to defecate at random in a large, unfenced rural yard for one week. Each defecation was flagged and, every 2 days and at the end of the trial, all fecal piles were collected and the defecation sites decontaminated with a propane gun. Quantitative egg counts (n=6 each, McMaster) were done at the beginning of the trial, individual fecal weights (n=50) and total fecal output for the week were determined, and the area contaminated was calculated. The puppies were shedding an average of 11,433 (range 6,600-15,600) and 10,533 (range 6,800-14,200) *T. canis* eggs/g feces, respectively; at the end of the trial, 12 female/8 male and 9 F/10 M worms were recovered upon treatment with pyrantel pamoate. On average for both pups, 10,983 eggs/g were shed, in a defecation weighing 26.8 g (range 15.1-53.6 g), for an average output of 294,454 eggs/defecation. Total fecal/egg output for both pups for the one week was 1870.7 g feces and 20,545,459 eggs. At this rate, the minimum contamination by the pups over 8 and 32 weeks, respectively, would be 164.4×10^6 and 657.5×10^6 eggs, and would likely increase as additional worms entered the intestine. Most defecation took place within 40 feet of the house, so that the main area contaminated was 40 by 70 feet (2800 ft^2). By the end of the week, however, the puppies were venturing as far as 140 feet away and also entering the wooded/weedy perimeter to defecate. The entire area outlined by their defecations was 12,340.5 ft^2, or between 1/4 and 1/3 acre. These results provide quantitative evidence of the extensive contamination of the domestic environment by untreated puppies.

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EXPERIMENTAL TRANSMISSION OF *HEPATOZOON AMERICANUM* TO DOGS BY THE GULF COAST TICK, *AMBLYOMMA MACULATUM*. J. S. MATHEW[1,*], S. A. EWING[1], R. J. PANCIERA[2], J.P. WOODS[3]. [1]Department of Infectious Diseases and Physiology; [2]Department of Anatomy, Pathology and Pharmacology; [3]Department of Medicine and Surgery, College of Veterinary Medicine, Oklahoma State University, Stillwater, OK 74078

Experimental transmission of *Hepatozoon americanum* to dogs was attempted with four ixodid ticks, viz., *Rhipicephalus sanguineus*, *Amblyomma americanum*, *Amblyomma maculatum* and *Dermacentor variabilis*. Ticks that dogs ingested included some that were laboratory-reared and experimentally fed as nymphs on a dog with naturally occurring hepatozoonosis; other ticks were collected as replete or partially engorged larvae, nymphs and adults from dogs that had hepatozoonosis and natural infestations of ticks. Whole ticks used to expose susceptible dogs orally were partially dissected to help release oocysts. Among eight dogs exposed, only the three that were fed *A. maculatum* adults experimentally acquisition-fed as nymphs became infected. Dogs developed elevated body temperature and other evidence of clinical disease starting 4 weeks after exposure. "Cysts" typical of *H. americanum* were found in skeletal muscle when samples were first examined 5 weeks after dogs ingested ticks, and parasites were also observed in peripheral blood smears at approximately the same time. Our study demonstrates that *A. maculatum* nymphs can acquire *H. americanum* by feeding on a parasitemic dog and that transstadial transmission of the protozoan occurs, with dogs acquiring infection when they ingest newly-molted adult ticks.

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EQUINE PROTOZOAL MYELOENCEPHALITIS (EPM): SEROPREVALENCE AND RISK FACTORS IN MICHIGAN HORSES

ROSSANO MG *, KANEENE JB, MANSFIELD LS COLLEGE OF VETERINARY MEDICINE, MICHIGAN STATE UNIVERSITY, EAST LANSING, MICHIGAN, USA 48824

In 1997, a cross-sectional study of serum antibodies to *Sarcocystis neurona* was performed in Michigan equine. A random, weighted sample of Michigan horse farms, stratified by the state's opossum population and the number of horses on each operation was drawn. 120 stratum-specific equine operations agreed to participate, and blood collection occurred from late March through December of 1997. Data regarding the farms' feeding and management practices were collected, as well as descriptive data for each individual horse. Serum samples were tested by a Western blot test for antibodies to *S. neurona*. A data set consisting of serum samples and corresponding questionnaires from 1139 equine and 98 farms was used for the analysis. In addition to the risk factor associated with the opossum population, risk factors associated with how horses were fed, watered and housed were analyzed. A summary of the prevalence of serum antibodies to *S. neurona* will be presented, and specific risk factors will be discussed.
(Supported by the Michigan Animal Health Initiative Grant.)

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TITLE: "New Molecular Methods for Pathogen Detection", byJames Higgins, Immunology and Disease Resistance Laboratory, USDA-ARS, Beltsville, MD 20705

ABSTRACT: Nucleic-acid based assays have greatly improved the ability of investigators to detect pathogenic microorganisms in clinical and environmental samples. A recently developed technique, the Perkin Elmer TaqMan™ 5' nuclease assay (5NA), combines a fluorogenic probe with PCR to provide real-time analysis for amplification-based protocols. Data from 5NA for brucellosis, plague, and tularemia will be presented, demonstrating the utility of this assay for pathogen detection in clinical samples, and in arthropod vectors. This presentation will also discuss recent DOD-sponsored advances in automated nucleic-acid extraction procedures, and miniature thermal cycler platforms

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EVALUATION OF MELARSOMINE DIHYDROCHLORIDE (IMMITICIDE®) FOR ADULTICIDAL ACTIVITY AGAINST *DIROFILARIA IMMITIS* IN CATS. L.W. MCLEROY[1]*, J.W. MCCALL[1], M.T. DZIMIANSKI[1], AND N. SUPAKORNDEJ[2]. [1]COLLEGE OF VETERINARY MEDICINE, UNIVERSITY OF GEORGIA, ATHENS; [2]TRS LABS, INC., ATHENS, GA.

This study was initiated to evaluate the adulticidal activity of melarsomine dihydrochloride against heartworms in cats, using both the standard (two 2.5 mg/kg doses IM, 24 hrs apart) and alternate (one 2.5 mg/kg dose IM, followed 1 month later with two 2.5 mg/kg doses IM, 24 hrs apart) dosing regimens approved for dogs. Twenty-four laboratory-raised cats were each given, via jugular venotomy, 3 male and 3 female adult heartworms obtained from donor dogs infected 6.5 months earlier by SC inoculation of *D. immitis* L_3 and randomly allocated to 3 groups. Group 1 served as nontreated controls, Group 2 received the standard dosing regimen, and Group 3 received the alternate dosing regimen. Both treatment regimens were initiated approximately 1 month later (Day 0). Adult heartworm antigen levels, feline antibody levels to *D. immitis*, and microfilarial counts were monitored throughout the study. Radiographic and echocardiographic data collected during this study will be presented elsewhere. All cats were necropsied (Day 91) and examined for the presence of adult heartworms 2 months after the final treatment of Group 3.

Both the standard and alternate dosing regimens significantly reduced worm burdens when compared to the controls ($p < 0.05$). The standard dosing regimen was 78.6% effective in killing the adult heartworms; infection was cleared in 5 of the 8 cats (average recovery, 0.6; range, 0-3). The alternate dosing regimen was 85.7% effective, with 6 of 8 cats cleared of infection (average recovery, 0.4; range, 0-2). All control cats had live adult heartworms at necropsy (average, 2.8; range, 1-6). Most cats in all of the groups were positive for microfilariae prior to the initiation of treatment, but microfilaremia was low and transient in all 3 groups. With the exception of 5 cats (1-2/group), all cats were amicrofilaremic by Day 27. All 24 cats tested positive, by subjective scoring, for heartworm antigen and antibody to *D. immitis* prior to the initiation of treatment. Antibody levels in both treatment groups declined throughout the study, but all of the 24 cats were antibody-positive at necropsy. None of the average scores for treated cats was ever significantly lower than those for the controls. Average antigen scores for both treatment groups gradually declined after treatments were initiated, but were significantly lower than controls only at necropsy. All 8 control cats and 4 (1 in the standard regimen, 3 in the alternate regimen) of the 16 treated cats were antigen-positive just prior to necropsy. Although no adverse reactions to treatment at the standard and alternate dosing regimen were noted, a pilot study with 8 heartworm-naive cats indicated that the maximum tolerated, single IM dose of melarsomine lies between 3.5 mg/kg and 4.0 mg/kg.

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Persistent Efficacy of Doramectin Topical Solution Against Artificially-Induced Infestations of *Bovicola bovis* and *Solenopotes capillatus* in Cattle. L. SMITH*, RESEARCH AND DEVELOPMENT, INC., LODI, WI, J. LLOYD, J. WAGGONER, M. GRUBBS, R. KUMAR, AND E. NORELIUS, UNIVERSITY OF WYOMING, LARAMIE, WY, A. BRAKE AND T. SKOGERBOE, PFIZER ANIMAL HEALTH, LEE'S SUMMIT, MO.

Two studies were conducted to evaluate the persistent efficacy of doramectin topical solution, at a dose rate of 500 µg/kg, against artificially induced infestations of *Bovicola bovis* and *Solenopotes capillatus*. In each study, 34 lice-free beef calves were individually housed and randomly allocated to one of five treatment groups (T1, T2, T3, T4, and T5) on Day 0. On Day 0, animals in Groups T1 (10 calves) and T2 (6 calves) were treated with saline (1 mL/10 kg) or doramectin, respectively. Treatment Groups T3, T4, and T5 (6 calves each) were treated with doramectin on Days 35, 63, and 91, respectively. All treatment administrations were poured down the midline of the back. On Day 112, all animals were examined for *B. bovis* and *S. capillatus* infestations on the head, neck, shoulder, dewlap, rib cage, back, and rump body regions. *Bovicola bovis* and *S. capillatus* counts were zero for all animals. On Day 119, all animals were infested with 200 *B. bovis* (100 third instar nymphs and 100 adults) and 25 *S. capillatus* (12 third instar nymphs and 13 adults). On Day 126, all animals were infested with 200 adult *B. bovis* and 25 *S. capillatus* (12 third instar nymphs and 13 adults). *Bovicola bovis* and *S. capillatus* counts were performed by visual inspection of all animals on Days 133 and 140. Based on geometric means, the persistent efficacy of doramectin topical solution against *B. bovis* was 100.0, 99.5, 100.0, and 100.0% for persistence intervals of 126, 91, 63, and 35 days, respectively. The persistent efficacy of doramectin topical solution against *S. capillatus* was 74.9, 86.3, 94.9, and 100.0% for persistence intervals of 126, 91, 63, and 35 days, respectively.

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Persistent Efficacy of Doramectin Injectable Solution Against Artificially-Induced Infections of *Ostertagia ostertagi* in Cattle. C. R. REINEMEYER*, F.M. ANDREWS, UNIVERSITY OF TENNESSEE, C. H. COURTNEY, W. KUNKLE, UNIVERSITY OF FLORIDA, GAINESVILLE, FL, T. L. SKOGERBOE, J. M. CUNNINGHAM, AND D. J. WALSTROM, PFIZER ANIMAL HEALTH GROUP, LEE'S SUMMIT, MO.

Two studies were conducted to evaluate the persistent efficacy of doramectin injectable solution, at a dose rate of 200 µg/kg (1 mL/50 kg), against artificially induced infections of *Ostertagia ostertagi.* In each study, 32 calves, treated 14 days previously (Day –14) with fenbendazole orally at 10 mg/kg to clear any existing *O. ostertagi* infections, exhibited no trichostrongylid-type egg counts on Day –1. On Day 0, the animals were randomly allocated to one of three groups of ten animals each (T1, T2, and T3) or as one of the two larval viability monitor animals. On Day 0, animals in Groups T1 and T2 were treated with saline (1 mL/50 kg) or doramectin, respectively. Treatment Group T3 was treated with doramectin on Day 7. All treatments were administered in the lateral midline of the neck. On Days 21 to 35, approximately 1,000 infective *O. ostertagi* larvae were given daily by oral gavage to each animal in Groups T1-T3. On Day 35, the two larval viability monitor animals were given approximately 30,000 infective *O. ostertagi* larvae. Five calves from each treatment group (T1-T3) and one larval viability monitor were slaughtered on each of Days 49 and 50 for determining *O. ostertagi* burdens. Efficacy of doramectin injectable solution was calculated based on the percentage reduction in *O. ostertagi* burdens of doramectin-treated calves compared to saline-treated calves. Based on geometric means, the persistent efficacy of doramectin injectable against *O. ostertagi* at persistence intervals of 28 and 35 days was 99.2 and 90.7%, respectively.

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Preventing transmission of *Sarcoptes scabiei* var. *suis* infestations from sows to nursing piglets by a prefarrowing treatment with doramectin injectable solution. L. D. FIRKINS*[1], C. J. JONES[1], D. P. KEEN[1], J. J. ARENDS[2], L. THOMPSON[3], and T. L. SKOGERBOE[3]. UNIVERSITY OF ILLINOIS, URBANA, IL[1], S & J FARMS, WILLOW SPRINGS, NC[2], AND PFIZER ANIMAL HEALTH, LEE'S SUMMIT, MO[3]

Two studies were conducted in Illinois and North Carolina to determine the effect of treatment with doramectin injectable solution on preventing transmission of *S. scabiei* from sows to nursing piglets. Efficacy was determined by recovering mites from skin scrapings and evaluating clinical signs of mange. Approximately 42 days prefarrowing, 58 mange-free sows were experimentally infested in each ear with 200 *S. scabiei* (total of 400). Seven to 14 days prefarrowing, 24 sows were given doramectin injectable intramuscularly at a dose rate of 300 µg/kg body weight and 21 untreated sows served as controls. Skin scrapings for mite counts and lesion scoring for mange were performed on sows on day 0 (treatment day), day 21, and on day 35/42. Each sow was observed on days 0, 7, 14, 21, 28, and 35/42 for the incidence of scratching. Skin scrapings, lesion scoring, and observation of scratching were performed on the piglets at weaning and at the end of the nursery stage. Geometric mean mite counts for the untreated sows were 0.70 and 0.26 on days 21 and 35/42, respectively, and 0.0 for doramectin-treated sows over the same time periods ($P \leq 0.05$). Lesion scores and the incidence of scratching were both higher in the untreated sows as compared to the doramectin-treated sows during the same time periods ($P \leq 0.05$). Geometric mean mite counts from piglets farrowed by untreated sows were 0.50 and 0.60 at weaning and following the nursery stage, respectively, and 0.0 for piglets from doramectin-treated sows over the same time periods ($P > 0.05$). Lesion scores and the incidence of scratching were both higher in piglets from untreated sows as compared to piglets from doramectin-treated sows ($P \leq 0.05$). Treating *S. scabiei*-infested sows with doramectin injectable solution before farrowing eliminated mite infestation and prevented the transmission of *S. scabiei* to piglets.

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Efficacy of Moxidectin Oral Gel Against *Gasterophilus nasalis* and *Gasterophilus intestinalis* Infections in Horses. C.R. REINEMEYER*, EAST TENNESSEE CLINICAL RESEARCH, KNOXVILLE, TN, F.M. ANDREWS, UNIVERSITY OF TENNESSEE, KNOXVILLE, TN, D.W. ROCK AND P.J. SCHOLL, FORT DODGE ANIMAL HEALTH, PRINCETON, N.J.

A 3-meter, fiber optic gastroscope was used to screen 47 horses suspected of being naturally infected with bot larvae. Seventeen of 47 (36.2%) candidate horses harbored *Gasterophilus nasalis* larvae in the proximal duodenum and 46 of 47 (97.9%) had *G. intestinalis* larvae in the stomach. All horses infected with *G. nasalis* had concurrent infections with *G. intestinalis*. Fourteen horses with dual infections were allocated randomly to two treatment groups. Seven horses in Group 1 received 2% moxidectin oral gel once at a dosage of 0.4 mg/kg, and seven horses in Group 2 were untreated controls. Fourteen days after treatment, all horses were necropsied and the stomach and proximal duodenum were harvested from each. Bot larvae were recovered, identified to species and instar, and counted. At the label dosage, moxidectin oral gel was 100% and 96.7% effective against third instar larvae of *G. nasalis* and *G. intestinalis*, respectively ($P<0.05$). In addition to demonstrating the boticidal efficacy of moxidectin, this trial illustrated that gastroscopy/duodenoscopy is a feasible method for confirming infections with different species of bot larvae in the horse.

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Parasite Vaccines: Insights into Building New Biological Weapon Systems for Testing at the Host-Pathogen Front. D. A. BRAKE, Ph.D., ANIMAL HEALTH BIOLOGICAL DISCOVERY, PFIZER CENTRAL RESEARCH, PFIZER, INC., GROTON, CT.

The marriage of molecular and immunoparasitology two decades ago and subsequent birth of the modern discipline of parasite vaccinology has generated enthusiasm toward production of effective parasite vaccines for human and veterinary applications. Indeed, it can be argued that our current, comprehensive knowledge of i) relevant parasite and host genes, ii) parasite evasion and host immune strategies and iii) vaccine delivery technologies has stocked our parasite vaccine fighting arsenal to full capacity. Despite these incredible advances, the commercial output of new parasite vaccines has been virtually nonexistent. This reality highlights the need to continue convergence of effort on the integration of these three components into 'biological weapon systems' for testing in reliable, animal experimental models. Novel, breakthrough technologies could also serve a catalytic role in this process. This presentation will review the current status of the vaccine arsenal and highlight, through specific examples, the recent deployment of efficacious, experimental parasite vaccines.

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THE HIDDEN ANTIGEN APPROACH TO PARASITE VACCINES. NANCY WISNEWSKI*, HESKA CORPORATION, FORT COLLINS, CO

There is an increasing need for parasite control using non-chemical means. Insecticide resistance, cross-resistance, and consumer concern over chemical residues in food and the environment all have contributed to the desire for alternative control methodologies. The targeting of hidden or concealed antigens in the development of novel vaccines against hematophagus ecto- and endoparasites was conceptualized more than two decades ago. The principle of this strategy is to immunize the host with essential internal parasite antigens not normally exposed during typical host-parasite interactions so as to induce a potent immune response to the hidden antigens. Ingestion of host immunological components, such as antibody and complement, during a bloodmeal then can result in immune-mediated damage to the parasite such that viability and fecundity are compromised. There are numerous reports describing the use of hidden antigens in which partial protection was obtained against a variety of ectoparasites (ticks, mosquitoes, flies, lice) and the gut dwelling endoparasite *Haemonchus contortus*. The most successful example of a hidden antigen vaccine is the *Boophilus microplus* recombinant Bm86 cattle tick vaccine, in which antibodies are directed against a *B. microplus* 89 kDa glycoprotein located on the surface of tick gut digest cells. Generally, host immune responses against hidden antigens differ from those that occur against natural antigens which confer acquired immunity following repeated exposure. This presentation will review significant aspects of the arthropod and nematode hidden antigen literature, including implications related to these different immune mechanisms. Recent progress in the identification and characterization of relevant hidden antigen targets in the cat flea, *Ctenocephalides felis*, also will be discussed, including specific issues associated with designing a vaccine that is effective in the presence of antibody-degrading flea midgut proteases.

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Tick Modulation of Host Immunity: An Important Factor in Pathogen Transmission. STEPHEN K. WIKEL* and GEORGE B. SCHOELER, DEPARTMENT OF ENTOMOLOGY AND PLANT PATHOLOGY, OKLAHOMA STATE UNIVERSITY, STILLWATER, OK 74078

Immunological interactions at the tick-host interface involve innate and specific acquired host immune defenses against infestation and immunomodulatory countermeasures by the tick. Ticks stimulate host immune response pathways involving antigen-presenting cells, cytokines, B cells, T cells, circulating and homocytotropic antibodies, complement, granulocytes and other biologically active molecules. Ticks are capable of inhibiting: host antibody responses; activation of complement; T-cell proliferation; and, cytokine elaboration by macrophages and Th1-lymphocytes. Immunosuppressive proteins in tick salivary glands and saliva have been identified and characterized. Tick induced host immunosuppression facilitates bloodmeal acquisition and is an important factor in transmission/establishment in the host of tick-borne Borrelia burgdorferi. BALB/c and C3H/HeN mice display sequential changes in suppression of cytokine responses when repeatedly infested with Ixodes scapularis nymphs. Cytokine changes are correlated with tick transmission of spirochetes. A novel means of controlling both vector and vector-borne pathogen by an anti-immunosuppressant vaccine is proposed. Supported in part by the Centers for Disease Control and Prevention, U.S. Public Health Service.

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CURRENT KNOWLEDGE AND PRACTICAL APPLICATIONS IN LIVESTOCK PARASITISM: INTRODUCTORY REMARKS. J.C. WILLIAMS. DEPARTMENT OF VETERINARY SCIENCE, LOUISIANA STATE UNIVERSITY, BATON ROUGE, LA 70803.

Endo- and ectoparasites continue to be highly significant impediments which effect efficient cattle production. The content of this symposium was designed to update veterinarians, parasitologists, livestock entomologists and other animal health workers on current as well as developing means of diagnosis, control, and general understanding of infection/infestation. Topics to be considered by 5 speakers include: host genetic basis for infection and immunological aspects of gastrointestinal nematodes; epidemiology and current treatment strategies for gastrointestinal nematodes; innovative methods for control of ectoparasites; geographic information systems for detection and control of the liver fluke; and economic significance of neosporosis in cattle.

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Diagnostic, Immunologic, and Genetic Aspects of Nematode Parasitism in Cattle.
LOUIS C. GASBARRE, USDA, ARS, LPSI, IMMUNOLOGY AND DISEASE RESISTANCE LAB, BELTSVILLE, MD 20705

Gastrointestinal (GI) nematode infections remain a source of significant economic loss to American cattle producers. Reasons include: 1) an incomplete understanding of the interactions between the parasites and the host immune system, 2) lack of information concerning the role of host genes in determining resistance/susceptibility, and 3) limited tools for assessing parasite burdens in cattle. Studies indicate that most cattle exhibit effective protective immune responses after a relatively brief exposure to the parasites. The exception is Ostertagia ostertagi. Ostertagia is an extraordinarily strong stimulator of the immune system, but this stimulation does not result in protection from reinfection. Instead immunity is manifested by a reduction in egg output by the parasites. The weak protective immunity is not a result of the parasite residing in the abomasum, but instead may involve active evasion of the immune response by the parasite. Although most cattle become immune to GI nematodes with sufficient time and exposure, a small percentage remain susceptible to the parasites. A major factor controlling this susceptibility is the genetic make-up of the host. Studies indicate that the use of certain sires in a breeding program can increase the odds of producing susceptible calves by 15-20 fold. Because these susceptible animals produce eggs at high rates, these animals are very important for parasite transmission. Studies of the immunogenetics of GI nematode infections have shown that commonly used methods to measure parasite burdens in cattle parasite are very inaccurate in quantifying Ostertagia. This is a result of both an inherent lower fecundity of Ostertagia and the limiting of egg output by the immune system. As a result, Ostertagia infection can be easily underestimated in cattle with a history of previous exposure to the parasite.

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PRACTICAL CONTROL OF NEMATODE PARASITISM IN CATTLE. B.E. STROMERG*. DEPARTMENT OF VETERINARY PATHOBIOLOGY, UNIVERSITY OF MINNESOTA, ST. PAUL, MN 55108.

Strategic parasite control programs are based on the epidemiology of cattle nematodes. The absence of strategic programs generally results in using anthelmintics at the convenience of the producer, which may have little if any impact on parasite populations. Parasites can survive the cold winters in the north or the hot summers in the south. Infection can take place year round no matter how severe the weather. Therefore, the goal of a strategic parasite control program must the prevention of parasitism. What are the best times to use the short acting benzimidazoles or the long acting endectocides to control the parasites?

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CURRENT CONTROL METHODS FOR ECTOPARASITES. PHILIP J. SCHOLL*. FORT DODGE ANIMAL HEALTH, PRINCETON, NJ, 08543-0400.

Control of ectoparasites on animals has traditionally involved the application of various pesticides to the surface of the animal. These compounds include topical applications of organophosphates, natural pyrethrins, synthetic pyrethroids, and carbamates; and feed-through use of insect growth regulators (IGR's). Ivermectin, introduced in the early 1980's, began the era of the endectocides, products with both endo- and ectoparasitic activity. Other endectocides include the avermectins (ivermectin, doramectin, and eprinomectin) and the milbemycins (moxidectin). New chemicals which were originally developed with crop protection applications include fipronil, imidacloprid, and the pyrroles. Non-chemical, integrated management control strategies which may extend the effectiveness of these chemicals include cultural control/environmental modification, mechanical control, and biological control as well as host resistance mechanisms.

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BOVINE NEOSPOROSIS: EPIDEMIOLOGY AND IMPACT. J.P. DUBEY. USDA, ARS, PARASITE BIOLOGY AND EPIDEMIOLOGY LAB., LPSI, BELTSVILLE, MD 20705.

Neosporosis is a recently recognized disease of livestock and companion animals. It is caused by the protozoan parasite, *Neospora caninum.* Neosporosis is a major cause of abortion in cattle in the U.S. and many other countries. The full life cycle and sources of infection of this parasite are unknown. Vertical transmission is the only recognized mode of transmission. Abortion can occur throughout gestation, but is most common in mid-term fetuses. Repeat abortion can occur in the same cow and its progeny. There is no vaccine against neosporosis. Economic impact of nesporosis on the dairy industry will be discussed.

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DIAGNOSIS, EPIDEMIOLOGY AND CONTROL OF LIVER FLUKE INFECTIONS IN CATTLE. J. B. Malone. Louisiana State University. Baton Rouge, LA 70803

Potential economic losses to cattle producers in areas where *Fasciola hepatica* occurs are greatly magnified in wet, mild climate years. The amount of snail intermediate host habitat on individual cattle operations also accounts for great farm-to-farm variation in fluke risk within the same area. Current methods used to evaluate economic risk due to liver flukes are difficult to evaluate. Recent advances on use of climate-based forecast systems, soil-hydrology computer mapping models and ELISA diagnosis based on detection of coproantigen in fecal samples collected from pastures will be reviewed. The latter is reported to be semi-quantitative and more sensitive than fecal egg counts for control decisions in cattle harboring over 10 *F. hepatica.*

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