Winter 1997

FROM THE ASSISTANT DIRECTOR

This has been another productive year for us at the ADDL. The Bacteriology Laboratory continues to develop and implement PCR tests for various animal pathogens (see last issue, Fall 1997). The Virology Laboratory is now offering a test for persistently infected BVD cattle (see this issue, page 3).

In addition, faculty and staff of the ADDL continue to play an active role in national meetings of the American Association of the Veterinary Laboratory Diagnosticians (AAVLD) as well as the American College of Veterinary Pathologists (ACVP). Dr. Nick Macri, a graduate student, was presented the C.L. Davis Award for the outstanding graduate student from Purdue University at the last ACVP meeting held in Albuquerque, New Mexico last month.

As this year draws to a close, I am extremely thankful for another year of working at the ADDL, but even more importantly, I am thankful for the hard working employees of this laboratory.

Your comments about this newsletter as well as the services of the Animal Disease Diagnostic Laboratory are welcome. We look forward to hearing from you and serving your needs. We also wish you and yours the happiest and safest of holiday seasons.

HOLIDAY SCHEDULE

Purdue University will be closed on December 25, 26, 27, 28, 1997 and January 1 and 2, 1998. The ADDL will observe this holiday schedule. The answering service will be available for emergency purposes at 765-494-7440.

Feline Vaccine-Induced Sarcoma Survey

As I am sure you are aware, there is an association between vaccination and sarcoma formation in cats. In order to further understand this association, reporting of these neoplasms and other pertinent information is necessary. Therefore, the Animal Disease Diagnostic Laboratory is complying with the requests of USP by mailing a survey form to all practitioners when the diagnosis of feline sarcoma is made by pathologists of the ADDL. (For more information regarding the USP PRN, see JAVMA Vol 208, No 3, pages 361-363, Feb, 1996). We hope that you will participate in this study by completing the survey and mailing it to USP Practitioners' Reporting Network (a postage-paid envelope will be provided to you with the survey). Also, please note the current recommendations based on the Vaccine-Associated Feline Sarcoma Task Force as listed below.

- by Randy White, DVM, PhD

Initial Recommendations of the Vaccine-Associated Feline Sarcoma Task Force

The issue of alleged vaccine-associated sarcomas is clearly complex, and complete answers are expected only after the expenditure of considerable effort. In the interim, veterinarians and cat owners alike can make decisions that, hopefully, will reduce the possibility of sarcoma development and improve the chances of successful treatment. More complete recommendations will be made as information from the task force is generated, but, based on material from the AAFP, the Academy of Feline Medicine, and the California VMA, the task force presents the following:

The manufacturer's label recommendation is the only official item a veterinarian currently has to demonstrate the basis for vaccination.

Alternate vaccination routes (eg, nasal, topical) should be considered if and when available.

The use of vaccines packaged in single-dose vials should be encouraged.

Vaccination is a medical procedure, and protocols should be individualized to the patient. Administration of any vaccine should proceed only after duly considering the medical significance and zoonotic potential of the infectious agent, the patient's risk of exposure, and germane legal requirements.

Any occurrences of vaccine-associated sarcomas or other adverse reactions should be reported directly to the vaccine manufacturer and to the United States Pharmacopeia (USP). Information about the USP Practitioners' Reporting Program and a sample submission form can be found in the JAVMA, Vol 208, No 3, Feb 1, 1996, pp 361-363. Additional reporting forms can be obtained by calling 1-800-4-USP-PRN. Submission of the form can be facilitated by diagnostic laboratories if the laboratories include a report form with each diagnosis of vaccine-associated sarcoma. The record should include vaccine type, lot number, and vaccination site; this information should also be incorporated into the patient's permanent medical file.

To further characterize the causal link and to facilitate treatment of vaccine-associated sarcomas, the following general guidelines for vaccine (and other injectable product) administration are suggested:

Veterinarians should standardize vaccination (and other injection) protocols within their practice and document the location of the injection, the type of vaccine or other injectable product administered, and the manufacturer and serial number of the vaccine, in the patient's permanent medical record.

It is recommended that:

Vaccines containing antigens limited to panleukopenia, feline herpesvirus type-1, and feline calicivirus (+/- chlamydia) should be administered on the right shoulder, according to the manufacturer's recommendations.

Vaccines containing rabies antigen (- any other antigen) should be administered on the right rear limb, as distally as possible, according to the manufacturer's recommendations.

Vaccines containing feline leukemia virus antigen (+/- any other antigen except rabies) should be administered on the left rear limb, as distally as possible, according to the manufacturer's recommendations.

Injection sites of other medications should be recorded.

Testing for Persistently Infected BVD Animals

Dairy or beef cattle herds can now be screened for persistently infected BVD animals at the ADDL. The test involves cell culture virus isolation in a 96 well microtiter plate followed by detection of positives with an immunoperoxidase monolayer assay.

Animals to be tested should be at least 3 months old. By this age, maternal antibody should no longer be an inhibitory factor in the isolation procedure.

To interpret results accurately it is important to remember that a positive result from a single sample could be due to an acute or a persistent infection. The persistently infected or carrier animal should also be positive if a second sample, drawn three weeks later, is tested.

The test is not now being performed on a regular basis, but please notify the laboratory prior to submission of serums for this procedure.

- by Mary Woodruff, Professional - Medical Assistant

A Review of Congenital Portosystemic Shunting and Hepatic Encephalopathy

Heptic encephalopathy is a neurologic disorder which may develop in animals who have advanced liver disease and/or severe portosystemic shunting. Congenital porto-vascular anomalies, which allow portal blood to circumvent hepatic detoxification in affected dogs and cats, and chronic severe hepato-cellular disease with acquired intra- or extrahepatic portosystemic shunting (PSS) in dogs account for most of the cases of hepatic encephalopathy.

Signalment and History

Congenital PSS is more commonly seen in purebred (Yorkshire terriers and Miniature schnauzers) than in mix-breed dogs. Most animals are presented by 2 years of age, often by 6 months of age, and sporadically at any age. Owners' concerns are commonly related to neurologic, gastrointestinal, and/or urinary tract disorders. Furthermore, affected animals may have a history of stunted growth or failure to gain weight compared with unaffected littermates.

Laboratory Evaluation

The laboratory data may be consistent with hepatocellular dysfunction: hypoproteine-mia, hypoalbuminemia, hypoglobulinemia, hypoglycemia, decreased blood urea nitrogen, abnormal bile acid concentrations, mild hypocholesterolemia, and ammonia biurate crystalluria. Hematologic features may include microcytosis, target cells, poikilo-cytosis (especially in cats) and a hypo- or nomo-chromic mild non-regenerative anemia. Hyper-ammoniaemia is also a common finding in animals with PSS, and the ammonia tolerance test is consistently abnormal and equal in sensitivity to postprandial serum bile acid concentrations. However, combined fasting and 2-hour postprandial serum bile acid concentration determination is the test of choice for clinical evaluation of liver function.

Definitive diagnosis of a portosystemic shunt requires identification of the shunt by ultrasonography, contrast radiography, or exploratory laporatomy.

Histopathology

Histologic changes in the brains of human and animal patients with hepatic encephalopathy generally are mild and non-specific. Two microscopic changes are recognized: polymicrocavitation and Alzheimer type II astrocytes. Polymicrocavitation has a bilateral and symmetrical distribution. The lesion is located in the white matter of the cerebrum, internal capsule, thalamus, hypo-thalamus, and cerebellar medulla oblongata. Single or small groups of astrocytes with clear, swollen nuclei (Alzheimer type II cells) may also be found within the gray matter.

Microscopically, the liver contains features of hepatic atrophy, including small hepatic acini with a deficiency or lack of portal venous branches and a proliferation of hepatic arterial branches in the portal triads.

Pathogenesis

The pathogenesis of hepatic encephalopathy is multifactorial and not completely understood. The theories that have been proposed are based on two concepts. (1) Hepatic encephalopathy results when toxic metabolites from gastrointestinal bacteria are not removed from the portal circulation by the liver. Hepatic encephalopathy develops because of failure of the diseased liver to synthesize factors that are necessary for normal brain function. Gut-derived substances believed to be involved in the development of hepatic encephalopathy include ammonia, mercaptans, short chain fatty acids, false neurotransmitters, aromatic amino acids, gamma-amino-butyric-acid (GABA) and GABA like agents, and endogenous benzodiazepine ligands.

A Case Report

A 2.5 pound, female Dachshund puppy, reportedly 2 months old, was submitted dead for postmortem examination. The history included a one week duration of lethargy, biting at the cage and falling over backwards. No clinical pathology (hematologic or biochemical) test results were submitted.

Gross examination: A venous shunt connecting the mesenteric vein to the caudal vena cava was observed approximately 0.5 to 1 cm caudal to the liver (portal-caval venous shunt).

Microscopic examination: The brain contained multifocal, locally extensive areas of vacuolation within the white matter of the pons, cerebellar peduncle and cerebrum. In the liver, there was a slight increase in the number of profiles of hepatic arteries within the large portal tracts.

The microscopic lesions in the brain and liver were consistent with hepatic encephalopathy secondary to the portal-caval venous shunt.

References available upon request.

- by Lavun Anothayanontha, DVM - Graduate Student

Listeriosis

Listeriosis, also referred to as Circling Disease or Silage Sickness, is a sporadic bacterial infection caused by *Listeria monocytogenes*. Listeriosis is a worldwide disease, and affects a wide variety of mammalian and avian species, including man. Encephalitis is the most frequently recognized form of listeriosis of animals. The infection most commonly occurs in adult ruminants that are being fed contaminated silage.

Listeria monocytogenes is a small, motile, gram-positive nonspore-forming cocco-bacillus. This ubiquitous saprophyte lives in a plant-soil environment and can be found in soil, vegetables, sewage, genital secretions and nasal mucous of apparently healthy animals. The organism is very resistant to drying and can survive up to two years in dry soil and feces. It is also capable of growing well under a wide range of temperatures, 4 - 44° C.

There are four common manifestations of listeriosis: encephalitis in adult ruminants, septicemia in monogastrics and neonatal ruminants, abortion and perinatal deaths in all species, and mastitis in ruminants. It is uncommon for all forms of listeric infections to occur at one time within a flock/herd and for the majority, the infections are subclinical. However, when animals become stressed, immunocompromised or pregnant, clinical listeriosis often develops.

The route of infection seems to vary in accordance with the different clinical syndromes: encephalitis by small wounds in the buccal mucosa, while septicemia and abortions come from ingestion and inhalation.

Encephalitis is most prevelant in late winter and early spring when animals are confined and silage feeding is greatest. Silage fed from trenches or pits is most often the source of infection. The sides and lower, damper layers of silage from these pits seem to be the most contaminated because these sites are often exposed to air. This results in an aerobic decomposition of silage and an increase in pH (>5) which enhances the multiplication of *L. monocytogenes*.

L. monocytogenes commonly enters abrasions in the oral mucosa or at sites where teeth have fallen out and ascends via the trigeminal nerve to the brainstem. Here a unilateral, localized lesion is produced within the medulla oblongata and pons.

The number of animals affected clinically in an outbreak of listeriosis is usually low but mortality is extremely high. Sheep and goats are most susceptible to *Listeria* infections and are overcome by an acute disease with death occurring 4-48 hours after the onset of clinical signs. In cattle, infections are sporadic, less acute and most survive for 4-14 days. Spontaneous recovery may occur, but permanent CNS injury is frequent in these animals.

The clinical signs of affected animals include depression, fever, disorientation, and an indifference to their surroundings. They often separate themselves and crowd into corners and head press. They stumble and circle continuously. An associated head tilt is also commonly seen in these animals. Facial paralysis characterized by a drooping ear, dilated nostril and lowered eyelid (ptosis) on the same side as the lesion often develops. Intermittent twitching and paralysis of facial, throat and tongue muscles are usually present resulting in tongue protrusion, excessive salivation and dysphasia. A progressive paralysis develops throughout the course of the disease and in the terminal stages, the animal often falls and is unable to rise. Exhaustion followed by coma and death rapidly occurs once the animal has become recumbent.

Histological examination of brain tissue, preferably the brainstem, is necessary to demonstrate the monocytic perivascular cuffing and microabscesses that are characteristic of the disease.

Septicemic or visceral listeriosis is commonly observed among monogastric animals, including pigs, dogs, cats, rabbits and chinchillas, as well as neonatal ruminants. The clinical signs include an acute onset of depression, fever, anorexia, coughing and respiratory distress, diarrhea, prostration and death. The principle lesion is focal hepatic necrosis. For the septicemic form, the finding of multiple necrotic foci in any organ, especially the liver, is often highly suggestive of Listeriosis.

All pregnant domestic animals are susceptible to *Listeria* and an infection at this time often results in placentitis, fetal deaths, abortions, stillbirths, and neonatal deaths. Abortions in cattle are sporadic and occur within the last third of pregnancy. Abortion storms are more common in sheep and most abortions occur after the 12th week of pregnancy. When the placental tissues are retained, a secondary metritis often develops. This metritis is long lasting but has little or no effect on the animal's reproductive future. These animals commonly shed the organism in milk and vaginal secretions for a period of two months following an abortion episode.

Several suggestive gross lesions can be demonstrated in aborted fetuses. These include small yellow foci of necrosis in the liver, shallow abomasal erosions and a yellow-orange meconium. The fetus is often edematous and autolyzed masking these lesions. Dams and ewes should also be examined for placentitis and endometritis.

Mastitis is a rare manifestation of listeriosis. It affects only a single quarter and is unresponsive to antibiotics. Although uncommon, it does occur, and should be considered when dealing with chronic cases of mastitis in cattle.

The definitive diagnosis can only be made by the isolation and identification of *L. monocytogenes*.

Brain tissue, aborted placenta and fetus are the preferred specimens for culture. The organism is often difficult to grow and is commonly missed if not specifically requested. In the past, cold enrichment procedure incubated at 4° C was used for the isolation of *L. monocytogenes*. Recently, a more selective media established by USDA scientists, were adopted by the ADDL bacteriology lab. This method will decrease the long incubation time (1-2 months) to the cold enrichment protocol of 1-2 weeks. In addition, a PCR for *L. monocytogenes* has been developed by the ADDL bacteriology lab to detect *L. monocytogenes*. Other tests like immunohistochemical testing, using the perioxidase-antiperoxidase (PAP) method, has been used for the detection of *L. monocytogenes* antigen within brain tissue of infected animals. Both PCR and immuno-histochemistry methods are rapid and confirmatory, especially when inappropriate materials are submitted for other diagnostic methods.

Due to its ubiquitous nature, minimizing the opportunity for exposure seems to be the best preventive alternative against listeriosis. When an outbreak occurs, the affected animals should be immediately treated and isolated and those that have died should be destroyed or removed from the premises. Buildings should be thoroughly disinfected and cleaned and all bedding and feed should be burned. Silage feeding should be reduced and if spoiled, should be avoided. Other recommendations for silage fed herds/flocks may include: minimize soil contamination when making silage and filling the trench, perform routine silage testing and use additives to improve the fermentation process. It is extremely hard to totally eliminate *L. monocytogenes* from a surrounding environ-ment but the incidence of disease within a herd or flock can be significantly reduced if these recommendations are followed.

Listeriosis is also an important zoonotic disease. Aborted fetuses and necropsies of septicemic animals present the greatest hazard for veterinarians and agricultural workers. People have been reported to develop meningitis, septicemia, and a papular exanthema on their hands and arms after handling such tissues. Pregnant women are susceptible and at great risk of aborting if they are not properly protected from infection. The young, the elderly, and the immuno-compromised are most susceptible to infection and need to take precaution as well. The sources of infection include milk that was improperly pasteurized or contaminated after pasteurization, cheese by-products, and raw vegetation. Just as in animals, the only reasonable alternative for prevention is to minimize exposure and ensure the use of good personal and food hygiene to reduce the incidence of listeriosis within the human population.

- by Julie Stone, Class of 1998
- edited by Ching Ching Wu, DVM, PhD

Appropriate Use of Indirect ELISA for *Actinobacillus pleuropneumoniae* Based on Capsular Polysaccharides

The indirect ELISA for *Actinobacillus pleuropneumoniae* (APP) based on capsular polysaccharides is useful for surveillance of swine herds and detection of chronically infected animals. It can be used as part of a continuous health monitoring program. The ELISA detects antibodies to the capsular polysaccharide of APP serotypes 1, 3, 5 and 7. Since the serotype specificity resides in the capsular polysaccharides it is also a good test for differentiation of serotypes.

Cross reactivity between serotypes that are observed in the same sample or between serum samples from the same herd could be due to: (1) cross reactivity due to antibodies against "APP-like" organisms; (2) cross reactivity with serotypes that do not cause disease but may produce an antibody response (e.g. serotypes 4 and 7, serotypes 1 and 9).

For the above reasons it is best to use the test to screen samples from apparently healthy animals. In addition, it is important to test appropriate age groups of animals and optimal number of serum samples. Without testing a sufficient number of animals it is difficult to determine if a herd is free of APP. Published reports indicate that a minimum number of 30 serum samples, irrespective of the herd size, should be tested before a decision is made.

When testing for introduction of animals into new herds, a sufficient number of animals should be tested from the herd of origin. Testing only animals that are to be introduced may not provide you the correct information. Negative results obtained from quarantined animals do not guarantee that they are free of APP.

In the case of serological monitoring for APP, results of the ELISA should be supplemented by information on bacterial isolation. Deaths due to respiratory illness should be thoroughly investigated and APP bacterial isolation attempted. The results should be recorded and used in conjunction with the ELISA results.

Please consider the following guidelines when you request serological tests for APP:

Be sure to select the appropriate target population.

Be sure to test a representative number of animals.

Decide which serotype(s) of APP is (are) important for your producer.

There is no serological test that is 100% sensitive: remember that the number of positive results may also depend on the prevalence of the infection.
There is no serological test that is 100% specific, even though this figure was obtained during the validation of the test. The real and absolute "field" specificity of a serological test may never be known, since animals may come in contact with hundreds of different bacterial species that will never be tested for possible cross-reactions with APP.
Use results from the laboratory as a diagnostic tool: you have to correlate them with other information available. The final decision on the real health status of the herd (regarding APP) will be up to you.
A serologically negative result during the quarantine, even if it is repeated twice, does not ensure that one specific animal is not a carrier of APP if the serological status of the herd of origin is positive, suspicious, or unknown.
*Adapted from, "M. Gottschalk and R. Bilodeau, 1995, Detecting carrier animals in herds chronically infected by *Actinobacillus pleuropneumoniae:* the detection of antibodies and the detection of the bacteria. Allen D. Leman Swine Conference".
- by Thiagu Dorairajan
- edited by Ching Ching Wu, DVM, PhD

Antimicrobial Susceptibility Survey

1/97-10/97

An antimicrobial susceptibility survey over time is an excellent way to monitor the development of resistant pathogenic bacteria. The following tables (Tables 1-3) summarize the antibiogram for pathogens isolated, during January to October of 1997, from swine (Table 1), bovine-dairy (Table 2) and bovine-beef (Table 3).

"% S" indicates the percentage of organisms isolated from sick animals which were susceptible to the testing antibiotic(s) *in vitro*. Organisms with MS (moderately susceptible), I (intermediate) or R (resistant) are not included at this time. Therefore this data represents the most stringent susceptibility results. Please keep in mind that even though the *in vitro* data may not totally reflect the *in vivo* efficacy of an antibiotic, it remains the most reliable means to select for the best antibiotic(s) and the dose(s).

As you are browsing through the table of interest, please keep in mind that the data did not account for moderately susceptible organisms. Therefore, one should not be overly concerned with the fact that 0% (N=300) of *E. coli* from pigs are susceptible to Tylosin. This is merely stating that all *E. coli* tested were not susceptible to tylosin at its lowest effective dose. Tylosin may be effective at a higher dose and only through the susceptibility data, and effective dose can be prescribed for efficient treatment.

Porcine Susceptibilities
1/97-10/97

	Actinobacillussp.		*Bordetellabronchiseptica*		*Escherichiasp.*		*Escherichiahemolytic*		*Erysipelothrixrhusiopathiae*	
ANTIMICROBIC	#	%S	#	%S	#	%S	#	%S	#	%S
*Amikacin	16	100	53	100	301	99	91	99	9	22
Amox/Clava	11	91	39	46	180	36	53	49	2	50
*Ampicillin	16	63	53	11	301	40	91	52	9	11
Apramycin	16	44	52	29	300	67	91	62	9	11
*Cefitofur	16	94	53	2	300	97	91	96	9	100
Cephalothin	16	94	53	13	301	46	91	37	9	100
Clindamycin	6	17	17	0	126	0	39	0	8	75
Enrofloxacin	16	100	52	98	301	99	91	99	9	89
*Erythromycin	16	6	53	0	301	0	91	0	9	100
Florfenicol	5	100	14	7	120	3	38	5	4	75
*Gentamicin	16	100	53	100	301	71	91	64	9	33
*Lincomycin	10	0	36	0	175	0	52	0	1	100
Neomycin	16	75	52	100	300	44	91	54	9	33
Novobiocin	16	31	52	88	300	1	91	2	9	11
Oxacillin	16	44	53	17	301	3	91	3	9	100
*Penicillin	16	31	53	0	301	2	91	0	9	89
Sarafloxacin	5	80	14	7	120	95	38	95	4	100
*Sulfadiazine/T	11	55	38	5	179	2	53	2	2	0
Spectinomycin	16	6	52	2	300	12	91	27	9	89
Sulfachloropyr	16	94	52	12	300	26	91	27	9	33
*Tetracycline	16	44	53	98	301	2	91	3	9	22
*Tiamulin	16	63	52	0	300	28	91	24	9	89
Tilmicosin	16	75	52	10	300	2	91	2	9	78
Tribrissin	16	38	52	9	301	41	91	41	9	44
Tylosin		16	13	52	0	300	0	91	0	9

% S = % susceptible

* = FDA approved therapeutic agents for swine

Actinobacillus sp. - includes A. equuli, A. suis, and A. ureau.

Escherichia sp. - includes E. coli, lactose E. coli, and E. fergusonii.

Porcine Susceptibilities

1/97-10/97

	Hemophilusparasuis		*Actinobacillus*pleuropnemonia		*Klebsiellapneumoniae*		*Pasteurellasp.*	
ANTIMICROBIC	#	%S	#	%S	#	%S	#	%S
*Amikacin	25	84	82	56	19	100	215	99
Amox/Clava		17	59	98	9	89	142	95
*Ampicillin	25	92	82	77	19	0	215	95
Apramycin	25	56	82	7	19	89	215	35
*Cefitofur	25	96	82	99	19	100	215	97
Cephalothin	25	92	82	96	19	100	215	96
Clindamycin	11	91	27	7	10	0	82	1
Enrofloxacin	25	`100	82	100	19	100	215	100
*Erythromycin	25	92	82	10	19	0	215	1
Florfenicol	8	75	23	91	10	0	71	99
*Gentamicin	25	76	82	15	19	89	215	100
*Lincomycin	14	64	55	5	9	0	133	0
Neomycin	25	80	82	6	19	84	215	94
Novobiocin	25	96	82	11	19	0	215	96
Oxacillin	25	100	82	82	19	0	215	59
*Penicillin	25	68	82	56	19	0	215	60
Sarafloxacin	8	88	23	91	10	100	71	99
*Sulfadiazine/T	17	53	59	12	9	0	142	17
Spectinomycin	25	80	82	11	19	32	215	12
Sulfachloropyr	25	60	82	72	19	58	215	45
*Tetracycline	25	44	82	35	19	32	215	81
*Tiamulin	25	92	82	84	19	26	215	62
Tilmicosin	25	96	82	54	19	0	215	82
Tribrissin	25	48	82	33	19	53	215	39
Tylosin		25	96	82	20	19	0	215

% S = % susceptible

* = FDA approved therapeutic agents for swine

Actinobacillus pleuropnemoniae - includes types 1, 5, and 7.

Pasteurella sp. - includes *P. aerogenes, P. haemolytica*, and *P. multocida*.

Porcine Susceptibilities

1/97-10/97

	Staphylococcus aureus		Streptococcus *sp.*		*Staphylococcus sp.*		*Salmonella sp.*		*Streptococcus suis*	
ANTIMICROBIC	#	%S	#	%S	#	%S	#	%S	#	%S
*Amikacin	13	100	42	52	26	96	96	100	197	67
Amox/Clava	3	100	23	100	10	10	59	47	152	100
*Ampicillin	13	8	42	52	26	77	96	53	197	69
Apramycin	13	100	42	31	26	100	96	81	197	35
*Cefitofur	13	100	42	100	26	96	96	100	197	100
Cephalothin	13	100	42	100	26	100	96	92	197	100
Clindamycin	10	20	19	58	16	38	41	0	55	27
Enrofloxacin	13	100	42	83	26	88	96	100	197	87
*Erythromycin	13	23	42	38	26	50	96	0	197	43
Florfenicol	10	0	18	17	16	0	34	0	43	14
*Gentamicin	13	100	42	24	26	92	96	84	197	60
*Lincomycin	3	0	23	4	10	40	53	0	142	26
Neomycin	13	100	42	43	26	96	96	60	197	39
Novobiocin	13	100	42	100	26	88	96	0	197	98
Oxacillin	13	100	42	100	26	96	96	0	197	99
*Penicillin	13	0	42	100	26	19	96	21	197	88
Sarafloxacin	10	50	18	22	16	25	34	100	43	5
*Sulfadiazine/T	3	33	23	9	10	70	59	0	152	7
Spectinomycin	13	0	42	60	26	0	96	0	197	64
Sulfachloropyr	13	77	42	38	26	77	96	17	197	18
*Tetracycline	13	8	42	3	26	31	96	15	197	4
*Tiamulin	13	100	42	60	26	73	96	29	197	88
Tilmicosin	13	31	42	57	26	54	96	3	197	30
Tribrissin	13	85	42	48	26	65	96	46	197	31
Tylosin		13	31	42	38	26	58	96	0	197

% S = % susceptible

* = FDA approved therapeutic agents for swine.

Streptococcus sp. - includes *beta hemolytic*, *S. bovis*, group C *Strep*., and non-hemolytic *Strep*.

Staphylococcus sp. - includes *S. epidermidis* and *S. hyicus*.

Salmonella sp. - includes groups C1, B, D, and E1.

Bovine Dairy Susceptibilities
1/97-10/97

	Acinetobacter sp.		*Escherichia sp.*		*Hemophilussomnus*		*Klebsiella sp.*	
ANTIMICROBIC	#	%S	#	%S	#	%S	#	%S
*Amikacin	10	0	106	43	4	25	5	60
Amoxicillin	10	80	68	66	3	100	2	0
*Ampicillin	17	71	131	53	5	100	15	40
Apramycin	10	90	106	71	4	75	5	80
*Cefitofur	17	47	131	85	5	100	15	80
*Cephalothin	17	12	131	50	5	100	15	80
Clindamycin			46	0	1	100	3	0
Cloxacillin	7	14	25	0	1	100	10	0
Enrofloxacin	10	100	106	94	4	100	5	100
*Erythromycin	17	30	131	0	5	60	15	0
Florfenicol			38	0	1	100	3	0
*Gentamicin	10	100	106	68	4	75	5	40
Lincomycin	10	0	60	0	3	0	2	0
Neomycin	10	100	106	37	4	25	5	40
Novobiocin	10	40	106	0	4	100	5	0
*Oxacillin	10	10	106	2	4	100	5	0
*Penicillin	17	59	131	1	5	100	15	6
*Penic/Novobi	7	57	25	20	1	100	10	50
*Pirlimycin	7	0	25	0	1	100	10	0
Sarafloxacin			38	97	1	100	3	100
*Sulfadiazine/T	17	35	94	21	4	0	12	75
Spectinomycin	10	60	106	8	4	50	5	40
Streptomycin	7	43	25	20	1	0	10	40
Sulfachloropyr	10	70	106	34	4	0	5	20
*Tetracycline	17	88	131	34	5	60	15	54
Tiamulin	10	60	106	25	4	100	5	0
*Tilmicosin	10	70	106	2	4	100	5	0
Tribrissin	10	60	106	29	4	50	5	40
Tylosin		10	10	106	0	4	75	5

% S = % susceptible

* = FDA approved therapeutic antimicrobial agents.

Acinetobacter sp. - includes *A. calcoaceticus* and *A. lwoffi*.

Escherichia sp. - includes *E. coli*, lactose *E. coli*, hemolytic *E. coli*, and *E. fergonosii*.

Klebsiella sp. - includes *K. pneumoniae* and *K. oxytoca*.

Bovine Dairy Susceptibilities

1/97-10/97

	Pasteurella sp.		*Streptococcus afalactiae*		*Streptococcus sp.*		*Staphylococcus aureus*	
ANTIMICROBIC	#	%S	#	%S	#	%S	#	%S
*Amikacin	15	40	6	83	10	50	29	48
Amoxicillin	7	100			4	100		
*Ampicillin	15	93			73	74		
Apramycin	13	61			10	30		
*Cefitofur	15	100	6	100	73	97	29	100
*Cephalothin	15	93	6	83	73	100	29	97
Clindamycin	6	17			7	43		
Cloxacillin	2	100	6	83	63	87	29	97
Enrofloxacin	13	92			10	50		
*Erythromycin	15	13	6	83	73	82	29	86
Florfenicol	6	83			6	50		
*Gentamicin	13	100			10	60		
Lincomycin	7	0			3	33		
Neomycin	13	62			10	40		
Novobiocin	13	62			10	100		
*Oxacillin	13	62			10	100		
*Penicillin	15	46	6	50	73	53	29	38
*Penic/Novobi	2	100	6	83	63	95	29	97
*Pirlimycin	2	0	6	100	63	84	29	97
Sarafloxacin	6	83			6	33		
*Sulfadiazine/T	9	23	6	17	67	9	29	86
Spectinomycin	13	23			10	50		
Streptomycin	2	0	6	17	63	11	29	52
Sulfachloropyr	13	54			10	20		
*Tetracycline	15	74	6	100	73	47	29	93
Tiamulin	13	69			10	80		
*Tilmicosin	13	85			10	80		
Tribrissin	13	77			10	80		
Tylosin		13	8			10	80	

% S = % susceptible
* = FDA approved therapeutic antimicrobial agents.
Pasteurella sp. - includes *P. haemolytica* and *P. multocida*.
Streptococcus sp. - includes alpha hemolytic Strep, beta hemolytic Strep, *S. dysgalactiae*, group C *Strep*, non-hgemolytic *Strep* and *S. uberis*.

Bovine Dairy Susceptibilities

1/97-10/97

	Staphylococcus sp.		*Salmonella group B*	
ANTIMICROBIC	#	%S	#	%S
*Amikacin	3	67	23	48
Amoxicillin	1	100	14	21
*Ampicillin	38	76	23	13
Apramycin	3	100	23	78
*Cefitofur	38	97	23	87
*Cephalothin	38	97	23	74
Clindamycin	2	50	11	0
Cloxacillin	35	100		
Enrofloxacin	3	100	23	96
*Erythromycin	38	63	23	4
Florfenicol	2	0	9	0
*Gentamicin	3	100	23	83
Lincomycin	1	100	12	0
Neomycin	3	100	23	39
Novobiocin	3	67	23	0
*Oxacillin	3	67	23	0
*Penicillin	38	42	23	0
*Penic/Novobi	35	97		
*Pirlimycin	35	91		
Sarafloxacin	2	100	9	89
*Sulfadiazine/T	36	80	14	7
Spectinomycin	3	33	23	4
Streptomycin	35	77		
Sulfachloropyr	3	67	23	13
*Tetracycline	38	61	23	9
Tiamulin	3	67	23	26
*Tilmicosin	3	67	23	0
Tribrissin	3	67	23	35
Tylosin		3	67	23

% S = % susceptible
* = FDA approved therapeutic antimicrobial agents.
Staphylococcus sp. - includes *S. epidermidis* and *S. hyicus.*

Bovine Beef Susceptibilities

1/97-10/97

	Bacillus *sp.*		*Enterobacter sp.*		*Escherichia sp.*		*Enterococcus sp.*	
ANTIMICROBIC	#	%S	#	%S	#	%S	#	%S
*Amikacin	5	20	8	0	280	12	14	29
Amoxicillin	5	80	8	50	269	83	9	100
*Ampicillin	5	80	10	70	299	60	14	100
Apramycin	5	100	8	100	298	90	14	36
Cefitofur	5	60	10	100	299	88	14	50
Cephalothin	5	80	10	40	299	51	14	71
Clindamycin	1	0			32	0	5	60
Enrofloxacin	5	80	8	100	298	97	14	36
*Erythromycin	5	80	10	0	299	0	14	79
Florfenicol	1	100			28	0	5	0
*Gentamicin	5	100	8	100	298	80	14	50
Lincomycin	4	0	8	0	266	0	9	22
Neomycin	5	100	8	100	298	61	14	57
Novobiocin	5	100	8	0	298	1	14	79
Oxacillin	5	80	8	0	298	0	14	36
Penicillin	5	60	10	10	299	1	14	86
Sarafloxacin	1	0			28	93	5	0
*Sulfadiazine/T	4	75	10	50	270	2	9	0
Spectinomycin	5	20	8	38	298	4	14	29
*Sulfadiazine	5	80	8	100	298	38	14	21
*Tetracycline	5	60	10	100	299	23	14	21
Tiamulin	5	0	8	38	298	23	14	43
*Tilmicosin	5	100	8	13	298	1	14	64
Tribrissin	5	40	8	63	298	60	14	21
Tylosin		5	80	8	0	298	0	14

% S = % susceptible
* = FDA approved therapeutic antimicrobial agents.
Bacillus sp. - includes *B. cereus, B. pumis*, and *B. spherices*.
Enterobacter sp. - includes *E. agglomerans, E. cloacae*, and *E. intermedium.*
Escherichia sp. - includes *E. coli*, hemolytic *E. coli*, lactose *E. coli* and *E. fergisonii*.

Bovine Beef Susceptibilities

1/97-10/97

	Haemophilus somnus		*Klebsiella sp.*		*Listeria* monocytogenes		*Pseudomonas sp.*		*Pasteurella sp.*	
ANTIMICROBIC	#	%S	#	%S	#	%S	#	%S	#	%S
*Amikacin	30	10	12	0	4	25	14	7	82	12
Amoxicillin	26	85	12	75	4	75	13	30	72	86
*Ampicillin	30	80	13	15	4	75	14	21	82	68
Apramycin	30	60	12	83	4	50	14	100	82	56
Cefitofur	30	60	13	85	4	25	14	28	82	84
Cephalothin	30	87	13	77	4	50	14	28	82	83
Clindamycin	4	75			1	0	1	0	10	0
Enrofloxacin	30	87	12	100	4	25	14	100	82	82
*Erythromycin	30	70	13	0	4	75	14	14	82	7
Florfenicol	4	100					1	0	10	100
*Gentamicin	30	67	12	67	4	50	14	100	82	90
Lincomycin	26	8	12	0	3	0	13	7	72	0
Neomycin	30	53	12	67	4	50	14	93	82	65
Novobiocin	30	90	12	0	4	75	14	29	82	33
Oxacillin	30	90	12	0	4	0	14	21	82	57
Penicillin	30	77	13	0	4	75	14	29	82	60
Sarafloxacin	4	75					5	0	10	80
*Sulfadiazine/T	26	12	13	0	4	50	13	54	72	28
Spectinomycin	30	37	12	0	4	0	14	14	82	6
*Sulfadiazine	30	20	12	50	4	50	14	50	82	61
*Tetracycline	30	53	13	62	4	50	14	29	82	55
Tiamulin	30	80	12	33	4	0	14	21	82	33
*Tilmicosin	30	77	12	0	4	0	14	21	82	85
Tribrissin	30	70	12	58	4	75	14	57	82	78
Tylosin		30	80	12	0	4	75	14	7	82

% S = % susceptible
* = FDA approved therapeutic antimicrobial agents.
Klebsiella sp. - includes *K. oxytoca* and *K. pneumoniae*.
Pseudomonas sp. - includes *P. aeroginosa* and *P. fluorescens.*
Pasteurella sp. includes *P. hemolytica*, and *P. multocida*.

Bovine Beef Susceptibilities

1/97-10/97

	Streptococcus sp.		*Staphylococcus sp.*		*Salmonella sp.*	
ANTIMICROBIC	#	%S	#	%S	#	%S
*Amikacin	62	5	27	11	38	10
Amoxicillin	56	96	24	88	33	67
*Ampicillin	65	88	29	86	38	47
Apramycin	62	21	27	85	37	97
Cefitofur	65	97	29	86	38	92
Cephalothin	65	91	29	89	38	84
Clindamycin	6	50	3	33	6	0
Enrofloxacin	62	52	27	81	37	100
*Erythromycin	65	72	29	21	38	0
Florfenicol	5	20	3	0	5	0
*Gentamicin	62	47	27	85	38	84
Lincomycin	56	27	24	33	32	0
Neomycin	62	23	27	93	37	43
Novobiocin	62	92	27	89	37	0
Oxacillin	62	89	27	85	38	0
Penicillin	65	71	29	34	38	37
Sarafloxacin	5	20	3	0	5	100
*Sulfadiazine/T	59	8	26	54	32	0
Spectinomycin	62	40	27	15	37	0
*Sulfadiazine	62	16	27	70	37	35
*Tetracycline	65	28	29	55	38	39
Tiamulin	62	94	27	85	37	19
*Tilmicosin	62	65	27	85	37	0
Tribrissin	62	40	27	70	38	79
Tylosin		62	66	27	89	37

% S = % susceptible
* = FDA approved therapeutic antimicrobial agents.

Streptococcus sp. - includes *S. agalactiae*, alpha hemolytic *Strep*., non-hemolytic *Strep*. and *S. uberis*.
Staphylococcus sp. - includes *S. aureus, S. epidermidis*, and *S. hyicus.*
Salmonella sp. - includes C1, C2, B, and E1.