VETERINARY NEWSLETTER

UtahState UNIVERSITY extension

Dairy

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Utah State University, Utah Counties and the U.S. Department of Agriculture Cooperating

UTAH STATE UNIVERSITY DAIRY EXTENSION VETERINARIAN (TENURE TRACK) POSITION CANDIDATE SEARCH

After over 30 years of service, Dr. Clell Bagley will be retiring in early summer, 2007. This has resulted in the availability of a Dairy Extension Veterinarian position at Utah State University:

The Department of Animal, Dairy, and Veterinary Sciences at Utah State University is seeking applicants for a full-time tenure track faculty position of Assistant/Associate Professor in the area of Veterinary Science. This position will be approximately 75% Extension and 25% teaching. Candidates must have a Doctor of Veterinary Medicine (DVM) degree or equivalent degree from an AMVA accredited or ECFVG certified school and a minimum of one year clinical food animal experience. Candidates must be eligible for and will be expected to obtain a Utah Veterinary License. Review of applications will begin March 1, 2007 and continue until a suitable candidate is employed.

A quicklink to the job website is http://www.usu.edu/hr/, then click on Job Opportunities upper right and then click on Search Postings in the upper left navigation bar. The Req Id is 050670.

CURE RATES OF DIFFERENT ANTIBIOTIC TREATMENTS AGAINST BOVINE MASTIIS

There is continuing interest in the dairy industry in treatment options, and their associated cure rates against mastitis in dairy cattle. **Later in this article we will look at some very specific treatment, cure and pathogen information**. There was an interesting and concise review article published, titled "Bovine mastitis treatment failure", by Kiro R. Petrovski in the Dairy Cattle Newsletter of the New Zealand Veterinary Association, December 2006. It can be viewed electronically at:
http://www.milkproduction.com/Library/Articles/Bovine_mastitis_treatment_failure.htm

One thing that always strikes me about treatment of mastitis was reemphasized in several sections of this article. With our present state of knowledge, it is still true that many reasons why mastitis in cows, goats, and sheep can be difficult to cure are inherent characteristics of the mammary glands, their defenses, and the invading pathogens themselves. Weaknesses such as relatively poor neutrophil activity in milk or the ability of some mastitis pathogens to form microabscesses are factors we have limited control over. There is tremendous interest today in the genetics of immune response in humans and animals, including dairy cattle. The search for better vaccines against specific bacteria causing bovine mastitis is more than 100 years old. Our industry will hopefully realize benefits from this and be able to more successfully influence host response in the future.

And of course, the cornerstone of managing the disease complex of mastitis in dairy animals remains prevention, including environmental sanitation, teat dipping including predipping, dry cow therapy, etc. **However, for the last 60 years in the developed world, nearly half of all dairy animals contract mastitis at least once per lactation**. Therefore it is still true today that **one of the most practical mastitis treatment decisions most dairy producers, milking personnel and veterinarians make** is the choice of whether to use antibiotics at all to treat mastitis, which antibiotics if any, and the dose, route and duration of treatment. There is also marked interest today in homeopathic and other non-antibiotic treatments against mastitis. (From my perspective there has been interest since I can remember in mastitis treatment mixes like "Super Tonic" that a vet I knew made, aloe vera, wintergreen oil, apple cider vinegar, etc. Some of them have faded in and out of popularity at least twice since I graduated from veterinary school 25 years ago).

ANTIBACTERIAL RESISTANCE OR SUSCEPTIBILITY – DOES IT AFFECT CURE RATES OF MASTITIS?

A question that still comes up a lot is how much antibacterial resistance development has affected

treatment success or failure against mastitis. In a study published in the Journal of Dairy Science in October, 2003 by Pengov and Ceru, 76 bovine and 16 ovine strains of *Staphylococcus aureus* from mammary infections were tested. In results familiar to those who have seen very many antibiograms against this notoriously difficult to cure bacteria, widespread *susceptibility* to penicillin-G, ampicillin, kanamycin, cephalexine, and oxacillin was seen, and none of the strains were resistant to all of the antibiotics. In a recent study from Denmark, published by Bennedsgaard et al. in Acta Vet Scand Nov. 24, 2006, **20 conventional dairy herds, 18 herds farmed organically for at least 10 years, and 19 herds farmed organically for about 6 years** were compared for penicillin resistance of *S. aureus* mastitis isolates. There were no differences in penicillin susceptibility among the herd management groups, and 88% of the *S. aureus* were susceptible to penicillin. (There is a lot of interest in recent years in bovine *S. aureus* resistance to multiple antibiotics because of comparison with MRSA – Multiple/Methicillin Resistant *Staphylococcus aureus* – infections in humans, including nosocomial infections in hospitals and nursing homes all over the world. There is much higher prevalence of MRSA reported in hospital infections than in bovine mastitis infections).

What about other mastitis pathogens?

Erskine et al. published in Journal of Dairy Science in May, 2002 a study of 2778 mastitis bacteria isolated between 1994 and 2000. *Streptococcus uberis*, *Streptococcus dysgalactiae, Streptococcus agalactiae, Staphylococcus aureus, Escherichia coli, Klebsiella pneumoniae, Serratia marcescens*, and *Pseudomonas aeruginosa* were analyzed for susceptibility to penicillin, ampicillin, oxacillin, ceftiofur, cephalothin, sulfa-trimethoprim, gentamicin, erythromycin, pirlimycin, and tetracycline. Among most of the bacterial species, and for nearly every antibiotic, **there were some trends toward *increased* susceptibility over the 6 years**. The overall conclusion of the authors was "there was **no indication of increased resistance of mastitis isolates to antibacterials that are commonly used in dairy cattle**." Similarly, Dr. Petrovski in the review article cited above said, "Antimicrobial resistance or resistance development of mastitis causing organisms is obviously not the key to explaining the problem (of poor cure rates)."

CHOICE OF ANTIBIOTICS (OR NO ANTIBIOTICS) AGAINST BOVINE MASTITIS

A retrospective review was conducted of milk culture results from 11 years in New York and northern Pennsylvania. Samples were collected from farm visits to culture all (97%) or part of the lactating dairy herd for mastitis bacteria. Criteria were: 1) at least one mastitis pathogen present in the initial milk sample; 2) no signs of clinical mastitis; 3) cows definitively and permanently identified, and all mastitis treatments recorded on the farm; 4) milk from the same cow recultured within the next month, as part of another farm visit to resample the lactating herd; 5) treatment with an antibiotic or no treatment at all administered after the first milk culture sample and before the second culture sample was collected. An interesting aspect of this project was that many pathogens not generally recommended for antibiotic therapy were treated nevertheless. This was because of the decision of the dairy producer, and some of the treated mastitis pathogens were in cows concurrently infected with *S. agalactiae*.

There were 9007 cases of mastitis caused by 21 different pathogens, treated with 7 different antibiotics as well as cases with no treatment of any kind. **Cure rates for all cases combined and then for selected mastitis bacteria are summarized in the following tables, and when available a supplemental table with similar results from other studies is added**:

TABLE 1. Bacteriologic cure rates for 21 mastitis agents treated intramammarily with seven antibiotics or no treatment.

Treatment	Proportion of Cases Cured	Cure Rate
Untreated	4206/6481	65%
Amoxicillin	908/1103	82%*
Cephapirin	152/222	68%
Cloxacillin	463/632	73%*
Erythromycin	106/139	76%*
Hetacillin	35/56	62%
Penicillin	195/301	65%
Pirlimycin	32/73	44%*
All treatments[1]	1891/2526	75%*

[1]Combination of all antibiotic treatment categories.
* Significantly different than untreated cure rate of 65%.

Table 1a. Bacteriologic cure rates from similar trials, all mastitis pathogens combined.

Treatment	Proportion of Cases Cured	Cure Rate
Ceftiofur 2 days[1]	19/49	39%
Ceftiofur 5 days[1]	22/41	54%
Ceftiofur 8 days[1]	25/38	66%
Cloxacillin[2]	27/42	64%
Florfenicol[3]	17/44	39%
Florfenicol[4]	7/36	19%
Tylosin[5]	251/306	82%

[1]Oliver et al., J Dairy Sci, August 2004, 125 mg ceftiofur, subclinical mastitis cases
[2]Wraight et al., N Z Vet J, February 2003, clinical mastitis cases
[3]Wilson et al., AJVR, April 1996, 750 mg florfenicol, clinical mastitis cases
[4]Wilson et al., AJVR, April 1996, 750 mg florfenicol, subclinical mastitis cases
[5]McDougall et al., J Dairy Sci, February 2007, 5 g Tylosin, clinical mastitis cases

Table 2. Bacteriologic cure rates for *Streptococcus agalactiae* mastitis treated intramammarily with antibiotics or no treatment.

Treatment	Proportion of Cases Cured	Cure Rate
Untreated	31/116	27%
Amoxicillin	709/829	86%*
Cephapirin	115/175	66%*
Cloxacillin	376/487	77%*
Erythromycin	78/96	81%*
Hetacillin	28/45	62%*
Penicillin	139/222	63%*
Pirlimycin	32/73	44%
All treatments[1]	1477/1927	77%*

[1]Combination of all antibiotic treatment categories.
* Significantly different than untreated cure rate of 27%.

Table 2a. Bacteriologic cure rates from similar trials, *Streptococcus agalactiae* subclinical mastitis cases.

Treatment	Proportion of Cases Cured	Cure Rate
Ceftiofur[1]	1/36	3%
Cloxacillin[2]	NA	92%
Penicillin/novobiocin[3]	33/36	92%

[1]Erskine et al., JAVMA, January, 1996, 2.2 mg/kg ceftiofur, IM, SID, 5 days
[2]Davis et al., J Dairy Sci, December, 1975
[3]Erskine et al., JAVMA, January, 1996, 100,000 U procaine penicillin G, 150 mg novobiocin

Table 3. Bacteriologic cure rates for *Staphylococcus aureus* mastitis treated intramammarily with antibiotics or no treatment.

Treatment	Proportion of Cases Cured	Cure Rate
Untreated	472/1088	43%
Amoxicillin	30/70	43%
Cephapirin	6/14	43%
Cloxacillin	23/49	47%
Erythromycin	15/23	65%
Hetacillin	1/5	20%
Penicillin	15/23	65%
All treatments[1]	90/184	49%

[1]Combination of all antibiotic treatment categories.

Table 3a. Bacteriologic cure rates from similar trials, *Staphylococcus aureus* mastitis cases.

Treatment	Proportion of Cases Cured	Cure Rate
Ceftiofur 8 days[1]	NA	36%
Florfenicol[2]	2/11	18%
Florfenicol[3]	0/14	0%

[1]Oliver et al., J Dairy Sci, August 2004, 125 mg ceftiofur, subclinical mastitis cases
[2]Wilson et al., AJVR, April 1996, 750 mg florfenicol, clinical mastitis cases
[3]Wilson et al., AJVR, April 1996, 750 mg florfenicol, subclinical mastitis cases

It is important to note that in Table 3 above, the cows were cultured twice approximately one month apart in a large observational study. In Table 3a above, cows were cultured in duplicate before treatment, and again either 14 and 21 days, or 14, 21, and 28 days following treatment. The former regimen was acknowledged by the authors to possibly overestimate cure rates; the latter regimen is less likely to overestimate cure rates.

Table 4. Bacteriologic cure rates for streptococci other than *Streptococcus agalactiae* (*Streptococcus* spp.) mastitis treated intramammarily with antibiotics or no treatment.

Treatment	Proportion of Cases Cured	Cure Rate
Untreated	707/1070	66%
Amoxicillin	36/40	90%*
Cephapirin	3/3	100%
Cloxacillin	11/14	79%
Erythromycin	4/8	50%
Hetacillin	2/2	100%
Penicillin	9/11	82%
All treatments[1]	65/78	83%*

[1]Combination of all antibiotic treatment categories.
* Significantly different than untreated cure rate of 66%.

Table 4a. Bacteriologic cure rates from similar trials, *Streptococcus* spp. mastitis cases.

Treatment	Proportion of Cases Cured	Cure Rate
Cloxacillin[1]	NA	88%
Florfenicol[2]	4/10	40%
Florfenicol[3]	4/5	80%

[1]Davis et al., J Dairy Sci, December, 1975, subclinical mastitis cases
[2]Wilson et al., AJVR, April 1996, 750 mg florfenicol, clinical mastitis cases
[3]Wilson et al., AJVR, April 1996, 750 mg florfenicol, subclinical mastitis cases

Table 5. Bacteriologic cure rates for coagulase-negative staphylococci (*Staph* spp.) mastitis treated intramammarily with antibiotics or no treatment.

Treatment	Proportion of Cases Cured	Cure Rate
Untreated	1450/2011	72%
Amoxicillin	48/55	87%*
Cephapirin	16/18	89%
Cloxacillin	25/33	76%
Erythromycin	6/8	75%
Penicillin	17/25	68%
All treatments[1]	112/139	81%

[1]Combination of all antibiotic treatment categories.
* Significantly different than untreated cure rate of 72%.

Table 5a. Bacteriologic cure rates from similar trials, *Staph* spp.mastitis cases.

Treatment	Proportion of Cases Cured	Cure Rate
Ceftiofur 8 days[1]	NA	86%
Florfenicol[2]	2/3	67%
Florfenicol[3]	2/16	13%

[1]Oliver et al., J Dairy Sci, August 2004, 125 mg ceftiofur, subclinical mastitis cases
[2]Wilson et al., AJVR, April 1996, 750 mg florfenicol, clinical mastitis cases
[3]Wilson et al., AJVR, April 1996, 750 mg florfenicol, subclinical mastitis cases

Table 6. Bacteriologic cure rates for *E. coli*, *Klebsiella*, *Enterobacter*, *Citrobacter*, *Corynebacterium bovis*, *A. pyogenes*, *Pseudomonas*, *Pasteurella*, *Serratia*, and 8 other agents cases of mastitis treated intramammarily with antibiotics or no treatment.

Treatment	Proportion of Cases Cured	Cure Rate
Untreated	1546/2196	70%
Amoxicillin	85/109	78%
Cephapirin	12/12	100%*
Cloxacillin	28/49	57%
Erythromycin	3/4	75%
Hetacillin	4/4	100%
Penicillin	15/20	75%
All treatments[1]	147/198	74%

[1]Combination of all antibiotic treatment categories.
* Significantly different than untreated cure rate of 70%.

Table 7. Bacteriological cure rates for selected individual mastitis pathogens with no treatment.

E. coli	75/87	85%
Klebsiella	22/26	86%
Pseudomonas	16/17	94%
Pasteurella	6/7	86%

CONCLUSIONS ABOUT ANTIBIOTIC TREATMENT OF BOVINE MASTITIS (Suggested from the above tables)

All readers can make their own conclusions, but some suggested ones appear to me:

There is little published information on mastitis cure rates for antibiotics administered by routes other than intramammary infusion. It would be of interest to have more studies on IV therapy, including with antibiotics, against naturally occurring cases of bovine mastitis.

The cure rate for environmental mastitis pathogens was generally high whether antibiotic therapy was used or not. This appears to be especially true for coliform mastitis.

The antibiotic most strongly associated with higher cure rates than those for untreated cases was amoxicillin. This was true for all cases combined, and for the important Gram-positive pathogens *Streptococcus agalactiae*, *Streptococcus* spp., and coagulase-negative staphylococci (*Staph* spp.). I have recommended amoxicillin as the first choice for routine antibiotic therapy of mastitis, and for blitz treatment of *S. agalactiae* for many years based upon the data.

The ceftiofur data illustrates something that is probably true of many antibiotics; we use them for very short duration, usually only 2 - 4 milkings, approximately 24 – 36 hours of therapy. However, when ceftiofur was used for a period of 8 days, the elimination of mastitis bacteria was increased. The economics of treating mastitis cases with antibiotics for longer time periods with more doses of antibiotic need to be further evaluated. **Might there be an optimum duration of antibiotic therapy against mastitis** such that benefit of increased bacteriological cure rates exceeds the cost of additional treatment plus the increased milk discard? This almost certainly depends upon the causative bacteria; it could probably not be applied to all mastitis cases regardless of the bacteria.

ANTIBIOTIC TREATMENT AGAINST MASTITIS IN DAIRY GOATS

In a study by Poutrel published in Journal of Animal Science in February, 1997, effectiveness of dry treatment against mastitis was studied in dairy goats. Tubes containing a combination of penicillin, nafcillin, and dihydrostreptomycin were used; half of the does were dry treated and half were not. Dry period cures were determined by bacteriological culture of udder-half milk samples collected aseptically at drying-off and 2 wk after parturition. 40 of 202 (19.8%) udder halves were spontaneously cured in the untreated control group vs. 169 of 217 (77.9%) in the treatment group.

HOMEOPATHIC AND OTHER NON-ANTIBIOTIC TREATMENTS AGAINST BOVINE MASITIS

A study by Hu from China was reported in Zentralblatt fur Veterinarmedizin B in August, 1997. It reported on treatment of bovine mastitis with Houttuynin sodium bisulphate (HSB), which is obtained from a medicinal herb Houttuynia cordata Thunb. 52 cows were randomly selected for treatment of clinical mastitis with 80 mg of HSB aqueous intramammary infusion and 52 cases were randomly treated with 800,000 i.u. penicillin G in combination with 1 g of streptomycin (PS). Treatments were twice daily until mammary secretion became normal; exact duration of therapy was not reported. Treatment results are shown in Table 8:

Table 8. Bacteriologic cure rates for clinical mastitis cases treated with Houttuynin sodium bisulphate (HSB) or penicillin-streptomycin (PS).

Treatment	Proportion of Cases Cured	Cure Rate
HSB[a]	9/17	53%
PS[a]	11/20	55%
HSB[b]	16/35	46%
PS[b]	14/32	44%

[a] Acute cases
[b] Subacute cases

There was no significant difference in cure rate between treatments. It was suggested that a milk inhibitor test would be positive for 12 hours following HSB treatment vs. 48 hours with PS. I could not find other literature regarding HSB. I got some internet search hits suggesting that it has been studied in the Czech Republic in 2001.

Abaineh reported in Tropical Animal Health and Production from Ethiopia in December, 2001 on subclinical mastitis treatment with *Persicaria senegalense*, a leaf. When 0.77 kg of leaf powder was fed daily for 5 days, the bacteriological cure rate was 92.8% in the *Persicaria senegalense* treated group and 80.0% in an antibiotic treated control group; the antibiotic was not named. Numbers were not reported, but the difference was found statistically significant. In vitro, leaf extract inhibited growth of *Staphylococcus aureus, Candida albicans, Corynebacterium bovis* and *Pseudomonas aeruginosa* isolated from mastitis cases. I discovered that this is considered a weed throughout Africa. It is interesting that I do not recall other evidence of feeding something to cows that has an associated high cure rate for mastitis. Oral treatment with a weed might be of great use in Africa. Whether we would want any chance of introducing this weed to the US is another matter. Veterinarians often go to developing countries, however. Further study of feeding this weed to treat mastitis in Africa might be of interest. (The dose was equivalent to 3 kg of wet leaf).

In the journal Homeopathy, April 2005, Varshney reported on a homeopathic remedy from India. Made from *Phytolacca, Calcarea fluorica, Silica, Belladonna, Bryonia, Arnica, Conium* and *Ipecacuanha* this is also known by an apparent trade name, Healwell VT-6.

From several farms, 96 quarters with clinical mastitis (including 29 with fibrosis) were treated with Healwell VT-6 and 96 (none with fibrosis) were treated with various antibiotics, not specifically identified. Cure rates were reported only for the non-fibrosed quarters.

Presumably cure rates were low for the quarters with fibrosis, but this was not stated. Cure percentage for Healwell VT-6 cases was 58/67 (86.6%) and for the antibiotic treated cases it was 57/96 (59.4%). Statistical analysis was not reported. Mean cost of treatment was $0.47 US and $3.28 US, respectively. There are some more details it would be useful to know that were not in this report. Nevertheless, there is some evidence of effectiveness by this homeopathic remedy.

There is a need for considerably more research to evaluate alternative treatments for bovine mastitis. Many purported treatments have no published study results available. Information concerning efficacy, withdrawal times and safety would be useful. I hope to discuss any questions or thoughts about the mastitis cure rate data presented here with our readers

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