Dairy Session

Dr. Byford Woods, Chairman

Comparative Effectiveness of Different Dry Cow Treatment Systems

W. N. Philpot, *Ph.D.*
Mastitis Research Laboratory
North Louisiana Hill Farm Experiment Station
Louisiana State University
Homer, Louisiana 71040

Introduction

The practice of treating cows for mastitis at drying off is usually traced to the work of Pearson (23,24) in 1950. However, the practice was used as early as 1938 by Johnson (11) who administered acriflavin at drying off. Schalm and Ormsbee (39) also experienced success prior to 1950.

Pearson resorted to treatment at drying off in an effort to find a suitable method for preventing "summer mastitis" caused by infections with *Corynebacterium pyogenes* during the dry period. He reported that use of an aqueous suspension of sodium penicillin did not protect the udder against *C. pyogenes* infection because the drug persisted in the gland for only a few days. Subsequent trials with penicillin in oil reduced the incidence of dry period infections 47%, while the addition of aluminum monostearate to the mixture yielded a prophylactic value of 75% because of longer drug persistency. Johnson's acriflavin therapy was particularly successful against *Streptococcus agalactiae* infections. Schalm and Ormsbee reported cure rates against *Staphylococcus aureus* of 20.3 and 52.8%, respectively, when treatments were administered during lactation and the dry period. Thus, dry cow therapy provides both prophylactic and therapeutic benefits. Specific advantages are:

-higher persistency products can be used
-drugs are not eliminated from the udder by milking
-damaged tissue may be regenerated
-saleable milk is not contaminated with drug residues
-clinical mastitis is reduced at parturition.

The prophylactic and therapeutic benefits of dry cow therapy are evident in the work of Griffin (8) reported in Table 1. In the group receiving no treatment most infections present at drying off persisted to calving and a substantial percentage of previously uninfected quarters became infected, resulting in a higher level of infection at calving than at drying off. On the other hand, treatment at drying off eliminated a high percentage of existing infections, prevented most dry period infections, and resulted in a low level of infection at calving.

Research during the past 25 years has evolved mastitis control methods that are highly effective in the majority of dairy herds. The basic components are:

-correct use of functionally adequate milking machines
-good milking hygiene, with emphasis on teat dip-

Table 1
The Effect of Therapy at Drying Off on Infections Present, New Infections in the Dry Period and Levels of Infections at Calving (8).

			% Quarters			
Treatment	No. quarters	Pathogen	Infected at drying off	Infected at drying off, persisting to calving	With new infection at calving	Infected at calving
None	1144	Staphylococcal	10.3	9.5	5.3	14.8
		Streptococcal	13.7	11.1	4.3	15.4
		"Other"	0.7	0.4	1.3	1.7
1,000 mg. benzathine cloxacillin	1196	Staphylococcal	11.2	1.8	0.3	2.1
		Streptococcal	13.1	0.4	1.8	2.2
		"Other"	1.7	0.5	0.8	1.3

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-prompt and adequate treatment of clinical cases

-culling of animals with refractory infections

-dry cow therapy with high-persistency products.

Though each of the components is important, the objective of this paper is to consider methods of maximizing results from the latter.

Infections During the Dry Period

Researchers at the National Institute for Research in Dairying (NIRD) in England reported in 1950 (17) a high rate of new infections in the early dry period. More recent work from the same institute indicates that the probability of an udder's becoming infected is at least 20 times greater in early dry period as during a comparable period of the preceding lactation (21). Factors that seem to have the greatest effect on infection rates at this time are the fact that teats and udder are often contaminated with pathogens at drying off, plus the cessation of the flushing action of the teat canal by twice-daily milking. Subsequent trials demonstrated that the so-called plug or seal that forms in the streak canal during the dry period did not provide protection against infection (20,21).

Sinkevich, *et al.* (43), summarized results of experiments by several research groups in which the infection rate in cows treated at drying off was compared to an untreated control group. A weighted average of the data indicated that 10.8% of untreated quarters became infected, whereas, dry cow treatment reduced infections an average of 57.6%. Data reported by other workers showed similar patterns and, in the interest of brevity, are not cited here.

Factors Affecting Drug Persistency in the Udder

Excretion of antibiotic from a nonlactating udder is a function of the base in which the drug is formulated, dosage, and solubility of the antibiotic salt. Representative of such work is that reported by Smith *et al.* (45). Four treatment routines were compared.

Treatment 1 included .5 g cloxacillin infused in a quick release base which gave high initial levels of antibiotic but persisted for less than 6 days.

Treatment 2 included .5 g cloxacillin in a slow release base and gave relatively low levels of antibiotic for at least 3 weeks.

Treatment 3 included infusions with both treatments 1 and 2 and gave high initial levels of drug which persisted at low levels for at least 3 weeks.

Treatment 4 included infusion with treatment 2 at drying off and 3 weeks later, resulting in relatively low levels of antibiotic for at least 6 weeks.

All treatments were highly effective in eliminating streptococcal infections. The four treatments eliminated, respectively, 67.1, 79.7, 79.7, and 89.4% of staphylococcal infections present at drying off.

Roberts, *et al.* (36), compared the efficacy of two levels of a penicillin/dihydrostreptomycin mixture in combination with teat dipping. Both preparations were formulated in a long-acting base. The results are in Table 2 and emphasize the importance of dosage in a dry cow formulation, particularly when treating *S. aureus.*

Dry Cow Treatment Systems

Three basic systems of dry cow mastitis management are being used by dairy farmers, viz., no treatment, selective treatment, and routine treatment. Natzke (14) expanded these to six and developed a theoretical rating system for each as presented in Table 3. The first system is expensive both in terms of time and laboratory facilities and is not desirably effective for preventing new infections. The second is easy for the farmer but he derives no benefits. The thrid, fourth, and fifth systems also have definite limitations. Greatest benefits result from the routine treatment of all quarters.

Philpot (27) studied the feasibility of using the California Mastitis Test (CMT) to identify infected quarters; results are in Table 4. If CMT scores of 2 and 3 were used as the basis for treatment, 73% of quarters infected with common pathogens would have received therapy and 28% of quarters not infected with pathogens would have been treated. Natzke (14) studied data from approximately 20,000 quarters to obtain a measure of the value of using Whiteside reactions as a basis for dry treatment. The data are in Table 5. Treatment of all quarters with the two highest screening test scores would have accounted for only 39% of all infected quarters. If one assumes a cure rate of 50 to 60% against *S. aureus*, this method would permit approximately 80% of the infections to persist through the dry period.

Treatment on the basis of previous clinical history also has definite limitations, though a high percent of such quarters remains infected. Philpot (28) reported that 66% of quarters with clinical mastitis continued

Table 2
Comparison of Two Antibiotic Amounts for Dry Period Therapy (36).

	1,000,000 u penicillin & 1,000 mg dihydrostreptomycin			100,000 u penicillin & 100 mg dihydrostreptomycin		
	Quarters			Quarters		
Pathogen	No. treated	No. recovered	% recovered	No. treated	No. recovered	% recovered
S. aureus	713	622	87.0	102	55	53.9
S. agalactiae	1125	1089	96.8	150	135	90.0
Other streptococci	1607	1449	90.2	136	99	72.8
Other	214	192	89.7	20	18	90.0

Table 3
Theoretical Rating of Six Systems of Dry Cow Mastitis Management* (14).

System	Ease to dairyman	Cost	Prevent new infection	Eliminate existing	Response in decreased infection & increased production
Bacteriological survey & treatment	0	0	2	4	4
No treatment	5	5	0	0	0
Positive screening	3	3	3	1	1
Previous clinical	2	4	1	2	2
Combination	1	2	4	3	3
Treat all	4	1	5	5	5

*Best, 5; Poorest, 0.

Table 4
Comparison of California Mastitis Test Scores and Laboratory Cultural Results at Drying Off (27).

CMT	Bacteriological Status of Individual Quarters											
	Negative		*S. aureus*		*S. agalactiae*		Other streptococci		*C. bovis*		micrococci	
score	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
0	254	53	14	13	1	5	3	10	37	23	70	41
1	111	23	12	11	3	15	8	26	60	37	55	32
2	76	16	9	8	7	35	8	26	50	31	35	20
3	35	7	71	67	9	45	12	39	15	9	12	7

Table 5
Value of Treating on the Basis of Whiteside Reaction in Regard to Percent of Quarters Infected with Pathogens Which Are Contacted (14).

Whiteside	% infected quarters contacted				
reaction	All	*S. aureus*	*S. agalactiae*	Other streptococci	Coliforms
3	23	25	22	15	20
3+2	39	40	54	28	29
3+2+1	53	56	68	39	38
3+2+1+T	61	70	76	47	46

to harbor subclinical infection after clinical symptoms were eliminated by therapy. Schultze, Casman, and Lillie (40) grouped cows according to number of quarters requiring clinical treatment in the previous lactation. A determination was made of the cumulative proportion of cows in each group that were infected at drying off and of cows destined to become infected in early dry period. Considering all animals with a history of one or more clinical quarters during lactation they were able to predict 66% of infected quarters at drying off and 61% of those that were to develop a new infection in the dry period. Natzke (14) reported that treatment on previous clinical history was more effective than screening methods for predicting infected quarters. Such treatment reached 41, 27, 38, and 37% of *S. aureus, S. agalactiae*, other streptococcal, and coliform infections.

Thus, any form of selective treatment will fail to reach 30 to 60% of infected quarters. This situation is further compounded by the observation that the new infection rate in the dry period is greater for cows entering the dry period with at least one quarter already infected (17,40,44). These observations argue for the routine treatment of all quarters at drying off.

Results From Trials Comparing Different Dry Cow Treatment Systems

Though the literature on use of dry cow therapy as an integral part of a mastitis control program is voluminous, there are relatively few studies comparing different systems of treatment. Philpot and Pankey (31) conducted a 4-year study involving 267 cows to compare different dry cow treatment systems. The data are summarized in Table 6. Cure rates following treatment only at drying off were: *S. aureus*, 53%; and streptococci, 88%. Corresponding reductions in new infections in the dry period were: *S. aureus*, 52%; and streptococci, 61%. Cure rates following a single treatment at freshening with a lactating cow product were: *S. aureus*, 20%, and streptococci, 60%. Treatment at both drying off and freshening was no better than treating only at drying off. Incidence of clinical mastitis during the first 60 days after freshening was significantly reduced in the two groups treated at drying off. Philpot (26) com-

Table 6
Comparison of Four Dry Cow Treatment Systems (31).

Treated at		No. quarters infected 4 weeks after calving		Clinical cases
Drying off	Calving	*S. aureus*	All streptococci	0 to 60 days after calving
No	No	42	13	34
Yes*	No	20	8	20
No	Yes**	39	7	29
Yes	Yes	19	6	16

*One infusion with a high persistency product.
**One infusion with a lactating cow product.

Table 7
Summary of Results From a 3-Year Mastitis Control Program On 35 Herds Using Routine Dry Therapy in Year 1 and Selective Therapy in Years 2 and 3 (10).

	% quarters yielding			
Time	CMT positive	*S. aureus*	*S. agalactiae*	Other streptococci
Base period	34	26	4.9	3.1
1 year	14	11	0.3	1.8
2 years	12	13	1.2	2.9
3 years	12	13	0.5	2.3

pared the effectiveness of treating with a single infusion of a high-persistency product at drying off versus three infusions with a lactating cow formulation at 24-hour intervals at drying off. Efficacy of the two formulations was as follows: staphylococci, 50.9 and 22.6%; and streptococci, 93.9 and 85.7%.

A large-scale field trial involving 35 herds for 3 years was conducted in New South Wales, Australia (10). A milking hygiene routine was followed for the full 3 years, including the dipping of teats with a .5% iodophor product. Treatment was given during lactation only for clinical mastitis. The dry cow treatment phase of the study involved treating all quarters of each cow with 500 mg benzathine cloxacillin in a long-acting base at the first dry period. Subsequently, dry treatment was administered only to cows giving positive CMT reactions during the month prior to drying off. If one or two quarters were positive, treatment was given only to those quarters; if three or more were positive, all were treated. All lactating cows were sampled for bacteriological examination on two occasions at monthly intervals prior to implementing the control program, and all were sampled annually thereafter. Records of clinical cases were kept by the farmer. Reductions in mastitis incidence are summarized in Table 7. A substantial decrease was observed in all parameters during the first year but levels were basically static during years 2 and 3 when selective therapy was used. This observation is contrary to results from other large field trials (to be discussed later) in which routine dry therapy was followed for 3 years, accompanied by a further decrease in common pathogens. The incidence of clinical mastitis decreased from 108 cases per 100 cows in the first year to 64 and 47 cases in years 2 and 3. Changes in production per cow and cash flow over the 3 years are in Table 8 and reflect favorable trends. One must beg the question, however, "Would returns have been further increased if routine dry therapy had been continued?"

A trial involving 55 herds for 3 years was conducted in Israel (53). Intensive milking hygiene and routine dry therapy were practiced in Groups A and B, while animals in Group C were teat dipped and selective dry therapy was practiced on cows found infected by bacteriological examination or which had clinical mastitis in the last 2 or 3 months of lactation. A fourth group of animals served as the control. Data are summarized in Table 9. The greatest decreases in levels of infection were in Groups A and B. Group C which received selective therapy experienced a modest decrease in *S. aureus* infections but had an increase in infection with all pathogens combined.

Ward and Schultz (51) conducted a trial in four herds involving 402 cows in which alternate animals received complete or selective dry therapy. All quarters of cows in the complete therapy group were infused. Cows in the selective therapy group received treatment only in quarters with clinical mastitis during the last month of lactation. Treatments were with a product containing 500 mg neomycin sulfate. Complete therapy eliminated 29 infections while selective therapy eliminated 18. There were 45 and 75 new dry period infections in the two groups, respectively. The incidence of abnormal swelling and/or secretion during the dry period and first month of lactation was 75 and 165.

Serieys and Roguinsky (42) compared three systems, i.e., no treatment, partial treatment (which included all quarters of animals having a positive CMT reaction in one or more quarters during the last month of lactation), and routine treatment of all quarters. In each group half of the treated animals were infused with 500 mg benzathine cloxacillin and half with a preparation containing 1,000,000 u penicillin and 1 g streptomycin. Results are in Table 10. The small number of quarters infected at drying off and the high rate of infection in all groups during the dry period make it difficult to draw significant conclusions from the work.

Results From Field Trials in Which Dry Therapy Was Used

Several large field trials were conducted in which dry therapy was one component of a control program that also included teat dipping and good milking management (6,12,15,18,19). Though it is not possible to determine the precise effect of dry therapy on reduction in level of infection, it clearly had a major effect by eliminating existing infection. In two of the best known trials (MFE-3 conducted in England and one at Cornell) the level of infection with any pathogen decreased by more than 50% within 1 year and by about 75% within 3 years (see Table 11). This is in contradistinction to the New South Wales study in which total infections leveled off after selective dry therapy was instituted at the end of the first year. Infections with environmental pathogens remained

Table 8
Changes in Production Per Cow and Cash Flow Analysis
For 35 Herds for 3 Years (10).

Time	% production increase per cow per year Milk	Fat	Added value of product	Cost of program	Net benefit per cow
1 year	9	10	$12.50	$7.91	$ 4.59
2 years	15	16	$19.50	$5.00	$14.50
3 years	15	17	$20.50	$4.42	$16.08

Table 9
Summary of Data From Study in Israel on 55 Herds
For 3 Years (53).

	% cows infected with			
	All pathogens		*S. aureus* only	
Group	Beginning	End	Beginning	End
A	39.4	29.0	30.0	10.0
B	45.0	40.5	28.2	18.0
C	37.0	44.0	30.0	23.5
Control	46.0	49.0	33.0	31.5

Table 10
Comparison of Three Dry Cow Treatment Systems (42).

	No. infections			
Group	At drying off	Cured	New at calving	Total at calving
Control	24	10	29	43
Partial	27	23	25	29
Routine	15	10	18	23

Table 11
Effectiveness of Mastitis Control Programs
On Level of Infection for 3 Years (12,15).

	% quarters infected with any pathogen	
Time	MFE-3 (England)	Cornell study
Start	28.8	28.1
1 year	13.2	11.5
2 years	10.1	8.1
3 years	7.5	7.1

low throughout each of the trials.

Four additional field trials were conducted to evaluate utility of the teat dip/dry cow therapy/improved milking management programs in commercial herds. A minimum of professional supervision was involved. One trial involved 507 herds in Somerset, England, for 3 years (2). Herds following the full recommended program had a significantly lower cell count than control herds and clinical mastitis decreased. Herds that employed a partial control program were intermediate in response. In two trials conducted by the British Milk Marketing Board in 386 herds the geometric cell levels decreased 12.9 and 21.7% (1). A third trial involving 15 herds in a veterinary practice for 2 years experienced more than a 50% decrease in geometric cell counts (49). Clinical mastitis was 26% lower in the second year than in the first year.

Results From Other Trials

Eberhart and Buckalew (7) conducted two trials in which half of the cows were subjected to teat dipping and drying off therapy, while the other half were untreated controls. The infusion product contained 200,000 u penicillin and 100 mg dihydrostreptomycin and was administered to each quarter during the first week and again during the second week of the dry period. In the first trial quarters infected with *S. aureus* decreased from 9.5 to 2.9% and *S. agalactiae* from 21.8 to 1.6%. Clinical mastitis was not decreased in treated cows due, in part, to an increase in coliform infections. In the second trial the overall infection rate decreased 51.1% with no increase in incidence of coliforms.

In the interest of brevity the results from several additional trials are summarized in Table 12. Most of the products were in long-acting bases and efficacy was generally high.

Development of Resistance From Dry Therapy

Concern has been expressed by some workers that widespread use of antibiotics would result in the emergence of additional resistant strains of pathogens. The drug used most widely for dry therapy world-wide has been 500 mg benzathine cloxacillin. Resistance has not been observed, even among penicillin-resistant staphylococci which are often the primary target organisms. Rollins *et al.* (37) investigated the possibility that Gram negative bacilli might develop resistance in herds using a product containing 1,000,000 u penicillin and 1 g dihydrostreptomycin for long-term dry therapy. The investigation involved five herds that had used the drug combination for 3 to 4 years and five herds having no experience with the treatment. Their conclusion was that the repeated use of high doses of dihydrostreptomycin had little or no effect on resistance in *Escherichia coli* from either the environment or intestinal tract of cows. The long-term effects of using other drugs remain to be investigated.

The Coliform Threat: Fact Or Fiction

It is generally accepted that dry therapy is not effective in reducing incidence of coliform infection due, primarily, to the observation that incidence of coliform infection is usually about 0.5% of quarters and is not a problem at drying off. The period of greatest incidence is 1 week before and 1 week after parturition. The disease at this time is often due to:

-using careless treatment methods

Table 12
Efficacy Of Various Dry Cow Formulations

Reference	Antibiotic	Conc.	% cure rates			
			S. aureus	*S. agalactiae*	Other streptococci	All streptococci
(9)	Benz. cloxacillin	500 mg	81			99
(38)	Benz. cloxacillin	500 mg	65	95		
(13)	Benz. cloxacillin	500 mg	73			
(4)	Benz. cloxacillin	500 mg	69	93	85	
(29)	Benz. cloxacillin	500 mg	55			
(25)	Benz. cloxacillin	500 mg	56			100
(25)	Na cloxacillin	200 mg	60			
(5)	Na cloxacillin	200 mg	70			
(9)	Neomycin	500 mg	68			95
(25)	Penicillin	300 mg	38			90
(5)	Penicillin	25,000 u	44			
(5)	Benzylpenicillin	300,000 u	55			
(29)	Benz. Cephapirin	?	50			
(34)	Penicillin & dihydrostreptomycin	1,000 mg 500 mg	80	100	94	97
(29)	Penicillin & dihydrostreptomycin	1,000,000 u 100 mg	54			
(13)	Penicillin & novobiocin	300,000 u 250 mg	79			
(25)	Penicillin & novobiocin	250 mg	75			100
(25)	Penicillin & novobiocin	250 mg	64			100
(5)	Benzylpenicillin & novobiocin	300,000 u 250 mg	75			
(1)	Benzylpenicillin & dihydrostreptomycin	300,000 u 250,000 u	62			
(3)	Furaltadone & penicillin	500 mg 100,000 u	67	94	74	
(3)	Penicillin, nafcillin, and dihydrostreptomycin	300,000 u 50 mg 100 mg	79	76		

-maintaining dry cows in a dirty environment
-permitting cows to calve in a contaminated area
-not milking cows soon enough after freshening.

It also occurs more often in housed herds where herd hygiene is sub-standard and is associated with a buildup of organisms in bedding. The milking of wet udders and use of functionally inadequate milking equipment may also be major causes in some herds, though the disease is not highly contagious.

It is well known that coliform infections occur most often in low-cell-count quarters and it may be argued that reduction of gram-positive infections leaves a larger number of vulnerable quarters. The counter argument is that the discontinuance of dry therapy and teat dipping to maintain pre-existing infections with staphylococci and streptococci would be an extremely expensive control program for coliforms because 85 to 95% of the economic losses caused by mastitis are due to these two gram-positive organisms. Too, there is no substantive evidence that such a practice would prevent coliform infection. At best, only a small minority of herds on a teat/dry therapy program are at increased risk for coliform infection and most of those herds have substandard sanitation and management practices.

Rosenzuaig and Mayer (38) observed a significant increase in coliform infections in one herd on a dry cow treatment study but the high rate was accompanied by an increase in *S. agalactiae* infections which would go unnoticed in most herds. The problem was traced to faulty management practices. The 3-year field trial conducted at Cornell was extended for an additional 3 years in eight herds to determine if the significant reductions achieved in level of infection with common pathogens would eventually result in an increase with coliform infection (16). Continued use of the program maintained low levels of infection without an increase in coliform incidence.

Some workers question whether there has been an absolute increase in coliform infection over the past several years. It may be that we are seeing more of it because we are looking for it more diligently. Woods (52) stated he feels there has been an increase in coliform mastitis with endotoxemia rather than an increase in coliform mastitis as a whole. This author concurs with Dr. Woods' thesis and feels that fears of coliform mastitis in herds practicing dry therapy are exaggerated. The real cause is almost invariably related to management, though the exact causative practice is sometimes difficult to pinpoint.

Problems of Drug Misuse

Many problems may arise if drugs are used incorrectly. The so-called "home remedy" products often become contaminated with yeast, fungi, or other drug-resistant pathogens (22,29). Use of such products is more widespread than is generally recognized by government regulatory agencies.

The following is a case report of a large herd of 600

Table 13
The Effect of Infection at Different Times
On Milk Production at Calving (44).

Infection status of quarters at			
Drying off	Calving	Relative production	% depression
Negative	Negative	100.7	----
Infected	Negative	88.7	11.3
Infected	Infected	67.8	33.2
Negative	Infected	63.4	36.6

lactating cows with a high incidence of clinical mastitis. Therapeutic failures were frequent. An investigation revealed that the cases were caused by *S. aureus, Streptococcus sp., Pseudomonas aeruginosa,* and a variety of yeasts. Treatments were with a mixture prepared by the veterinarian which contained penicillin, neomycin, tetracycline, Furacin, and Flucort. The preparation was dispensed in screw-cap, 2000 ml containers and treatments were administered by lay personnel using multidose syringes and sterile cannulae. Visual examination of the preparation revealed that the ingredients had separated. Penicillin and Furacin are physically and chemically incompatible (22). Also, penicillin is bactericidal while Furacin and tetracycline are bacteriostatic. Combinations of bactericidal and bacteriostatic drugs should be avoided since there may be antagonism or depression of action (41). Stang (46) quoted the following general guidelines on use of antibiotics: a bactericidal agent plus a bactericidal agent results in synergistic effects; a bacteriostatic agent plus a bacteriostatic agent results in additive effects; and a bactericidal agent plus a bacteriostatic agent results in antagonism. Considering the highly effective commercial dry cow treatment products available to the veterinarian there appears to be no reason to formulate dry cow products. The incorporation of corticosteroids in intramammary products is contraindicated because, while having anti-inflammatory and toxin-neutralizing properties, they lower resistance of the host to infections by interfering with migration of phagocytes across the mammary epithelium. Uvarov (50) stated that use of corticosteroids in mastitis should be reserved only as parenteral therapy and should be accompanied by appropriate antibiotic coverage.

In a study conducted in New York, infusion products prepared by practicing veterinarians resulted in cure rates ranging from 44 to 97%, while a commercially prepared product yielded more consistent results (35). It was suggested that the poor results with practitioner-prepared products might be due to poor mixing of penicillin in the vehicle. Intramammary infusions should be made with commerical products in single-dose containers, except in the event of an epizootic with an uncommon and highly resistant pathogen, e.g., certain coliforms and mycoplasma.

Use of chlortetracycline for intramammary infusion at drying off caused treated animals not to produce milk following parturition (48). The cause was a chronic lesion in the teat and udder that consisted mainly of fibrous tissue.

Failure to use correct treatment methods may result in severe herd problems. Teats should be clean and dry. Each teat end should be disinfected by scrubbing for a few seconds with cotton soaked in 70% alcohol. A separate piece should be used for each teat, and teats on the far side of the udder should be sanitized first if more than one quarter is to be infused. Treatment should be in reverse order. Unless special care is taken in cleaning and sanitizing teats prior to infusion, organisms present at the teat apex may be forced into the udder and result in a more severe infection than the one for which treatment was intended.

Summary and Conclusions

If mastitis control programs are to be effective they must reduce both the rate and duration of infection. For dairy farmers to recognize a decrease in level of infection it is necessary that existing infections be eliminated. If untreated, most infections present at drying off persist to calving and the rate of new infection is high in uninfected quarters, particularly in cows already infected at drying off in one or more quarters (3,17,40).

The effect of infection at different times on milk production at calving was demonstrated by Smith, *et al.* (44); results are in Table 13. The elimination of an infection at drying off resulted in 21.8% more milk from the affected quarter during the first month after calving. Milk production of quarters which became infected during the dry period was reduced 36.6%. Natzke *et al.* (15) determined that quarters infected with a primary pathogen produced 1500 to 1700 pounds less milk per lactation than uninfected quarters.

Dry therapy results in both therapeutic and prophylactic effects if applied routinely to all quarters. The practice permits use of high persistency products that afford higher efficacies than is obtained from lactation therapy. It is also the simplest component of a mastitis control program because it is a once-a-year event, yet is highly effective in shortening duration of infections and in reducing the level of infection rapidly. Research has shown that a reduction in level is accompanied by a reduction in rate of new infection. The preferred time for treatment in most herds is immediately following the last milking of lactation. Abrupt cessation of milking is as effective as the intermittent method of drying off. In the case of high-producing cows it is best to discontinue grain feeding for a few days, reduce water intake, and feed hay.

Though dry cow therapy is an accepted practice on a large percentage of dairy farms, the farmer and his veterinarian must decide which quarters should be treated. Considering all relevant evidence the author is forced to conclude that *routine treatment of all quarters is the preferred approach for most dairy* *herds*. This method has the advantages of:

- -reaching all infected quarters
- -being more effective in preventing new dry period infections
- -not requiring laboratory or screening procedures (30).

Selective therapy can be used with some measure of confidence only when the level of existing infection is low (herd somatic cell levels consistently below 500,000) and when highly effective preventive practices are conscientiously applied.

The threat of increased incidence of infection with coliforms has been exaggerated and, at worst, only a small minority of herds, in which dry therapy is practiced, are at increased risk. Even then, the basic problem is generally one of mismanagement, rather than a direct result of dry therapy.

The reduction in level of infection is greatest during the first year of a mastitis control program. Natzke *et al.* (15) demonstrated that herds on a comprehensive control program produced 1051 pounds more milk per cow per lactation than the average New York Dairy Herd Improvement herd after adjustment for differences in initial production. Such programs return 3 to 5 dollars in increased milk production alone for each dollar required to carry out the program. Additional benefits result from:

- -fewer animals lost due to death or premature culling
- -less milk discarded from fewer clinical cases
- -fewer drugs used in lactation
- -less extra labor.

Perhaps, one of the greatest challenges confronting the successful bovine practitioner is to maintain the enthusiasm of dairy farmers for continuing effective control methods (such as dry cow therapy) after the level of infection has been substantially reduced. The benefits of success are well worth the effort.

Selected References

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