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BRIEF COMMUNICATION

Efficacy of antibiotic treatment at drying off in curing existing infections and preventing new infections in dairy goats

F.M. ANNISS AND S. MCDOUGALL

Animal Health Centre, PO Box 21, Morrinsville, New Zealand.

Infusion of antibiotics into the udder at the end of the lactating period ("dry cow therapy"; DCT) is an essential control measure for bovine mastitis (Smith *et al.*, 1967). Dry cow therapy eliminates existing intramammary infections (IMI) and reduces the incidence of new infections over the dry period with a resultant reduced prevalence of IMI at the commencement of the subsequent lactation (Smith *et al.*, 1967; Harmon *et al.*, 1986). The cure rate of existing infections after DCT has been reported as between 60-90% (Pankey *et al.*, 1982; Sol *et al.*, 1994; Browning *et al.*, 1990; Williamson *et al.*, 1995). Dry cow therapy reduces the new IMI rate by approximately 50% (Browning *et al.*, 1994; Williamson *et al.*, 1995).

Infusion of antibiotics at the end of lactation in dairy goats ("dry-goat therapy"; DGT) has been reported to cure between 66% and 100% of existing IMI (Fox *et al.*, 1992; Poutrel & de Cremoux, 1995; Poutrel *et al.*, 1997). However, the efficacy of DGT in reducing the new infection rate over the dry period has not been examined.

The aim of this trial was to assess the efficacy of intramammary antibiotic treatment of dairy goats at the end of lactation in curing existing mammary gland infections and reducing the incidence of new infections over the dry period and early in the subsequent lactation.

Duplicate milk samples were taken from 476 dairy goats from four herds, seven days prior to the end of lactation. Milk samples of ~5 ml were obtained from each gland following aseptic preparation of the teat end by scrubbing with a cotton wool ball moistened in 70% methylated spirits and cultured for bacteria. A single ~20 ml sample was also taken and analysed for somatic cell count. Animals were blocked by bacteriological status (0 = uninfected, 1 = one gland infected, 2 = two glands infected), ranked on age (1, 2, >3 years) and mean SCC of both glands seven days before the end of lactation, then randomly assigned to one of two groups within sequential pairs of goats within herds. Following the final milking, each gland within the treatment group was aseptically prepared as above and infused with a single intramammary syringe containing 300 mg of procaine penicillin, 100 mg of dihydrostreptomycin and 100 mg of nafcillin (Norfpenzal D.C., Intervet, Auckland, New Zealand) while the other does were left as untreated controls. Antiseptic (0.5% iodine in H_20) was applied to the teat end by spraying within 1 minute of treatment to all goats. Single milk samples were collected before the final milking for bacteriology. Duplicate milk samples were collected between 0 and 4 days post-kidding and again 3 to 4 days later for bacteriology.

For bacterial culture, a sub-sample of milk (10 μl) was streaked onto Columbia Sheep Blood (5%) Agar (Forte Richard Laboratories, Auckland) and incubated for 48 hours at 37°C. Bacteria were speciated on the basis of colony morphology, Gram stain reaction, catalase, coagulase and CAMP tests, using standard procedures from the National Mastitis Council Laboratory Handbook on Bovine Mastitis (Anon, 1999).

A gland was defined as infected if culture of two of the three pre-dry off samples resulted in growth of three or more colonies of the same bacterial species. A gland was defined as cured if the bacterial species present at drying off was not isolated from any of the samples taken post kidding. A gland was defined as newly infected if no bacteria were isolated at drying off and then three or more colonies of the same bacteria were present in either of the posting kidding samples, or if the bacterial species isolated post-kidding was different from the species isolated pre-dry off.

Data were analysed at gland level and it was assumed that glands within a goat were independent. Backward stepwise logistic regression was used to analyse cure and new infection rates. Initial analysis of the main effects (age, herd, treatment, bacterial species at drying off and length of the non-lactation period) was performed using univariate analysis (either χ^2 or logistic regression) and factors found to be associated ($P<0.2$) were then offered to the backward stepwise models. A number of glands were missed or the samples contaminated at subsequent samplings and were removed from the analyses.

The prevalence of IMI before drying off was 27.2% (258/948) of glands. Pathogens isolated included coagulase negative staphylococcus (CNS) (59.3% of all IMI), *Corynebacterium sp.* (Coryn) (29.1%), *Staphylococcus aureus* (SA) (6.2%), *Streptococcus agalactiae* (SAG) (4.3%) and other species (1.2%). Cure rate increased following treatment ratio (OR = 46.6 for treated compared to control; $P<0.01$; Table 1), decreased with age (38/56 (67.9%) vs. 97/167 (58.1%), OR = 0.46, $P=0.07$) for 1-year-olds compared to > 1-year-olds, respectively) and was lower for SA infections than other bacterial species (OR = 0.74, 0.06, 2.34, $P=0.50$, 0.00, 0.39 for Coryn, SA and SAG, respectively; with CNS as the reference category).

Treatment reduced the likelihood of new IMI compared to untreated controls (OR = 0.14, $P<0.01$; Table 1). Older animals were more likely to acquire a new IMI than younger animals (8/287 (2.8%), 12/245 (4.9%) and 29/314 (9.2%) for 1, 2 and >2-year-olds respectively, $P<0.01$). Glands with an IMI at dry off were less likely to acquire a new IMI than glands uninfected at dry off (6/238 (2.5%) vs. 43/609 (7.1%), OR = 0.15, $P<0.01$). There

TABLE 1: Summary of numbers and percentages of glands infected or uninfected at drying off and following kidding for goats treated by intramammary infusion of antibiotics (1 syringe of penicillin, dihydrostreptomycin and nafcillin per gland) at drying-off (treated) or left as untreated controls (Control).

Status at end of lactation			Cured			New infections		
		Enrolled	n	Total	%	n	Total	%
Uninfected	Treated	311				6	311	1.9
	Control	298				37	298	12.4
	Total	609				43	609	7.1
Infected	Treated	114	99	107	92.5	3	113	2.7
	Control	129	36	116	31.0	3	125	2.4
	Total	243	135	223	60.5	6	238	2.5

was a treatment by infection status interaction ($P<0.05$, Figure 1) as control glands within the uninfected group had a higher new IMI than treated but uninfected glands. Among the infected glands treatment had no effect on new IMI rate.

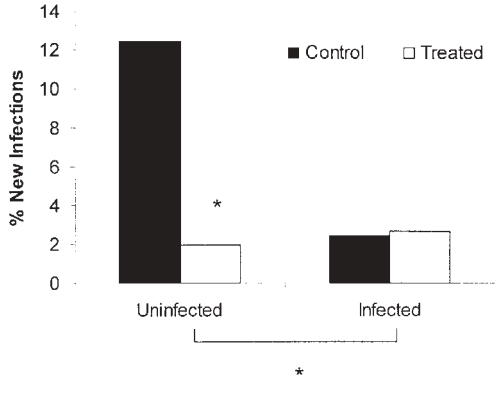
This trial demonstrated that infusion of antibiotics at drying off into the goat mammary gland reduced the number of new infections over the dry period and increased the cure rate of existing infections.

The cure rate of existing infections was 92.5% in treated and 31% in untreated glands which is similar to previous reports for goats (Fox *et al.*, 1992; Poutrel & de Cremoux, 1995) and cattle (Smith *et al.*, 1967; Sol *et al.*, 1994; Williamson *et al.*, 1995). In common with reports for cattle, the SA cure rates were low. This has been associated with poor penetration and distribution of antibiotics throughout the gland (Owens & Nickerson, 1990; Sol *et al.*, 1994; Sol *et al.*, 1997; Owens *et al.*, 1997) and the ability of SA to survive intracellularly (Owens & Nickerson, 1990). Similar to cattle, the higher cure rate in the younger animals may be due to a shorter duration of infection before treatment or reduced immunocompetence with age (Sol *et al.*, 1994; Sol *et al.*, 1997).

The number of new IMI across the non-lactating period was reduced from 9% to 2% following DGT which is consistent with cattle studies (Smith *et al.*, 1966; Browning *et al.*, 1990; Williamson *et al.*, 1995). New IMI rate was reduced by the presence of an IMI at drying off, and has been reported in dairy cattle, however the mechanism for this is not clear (Pankey *et al.*, 1982; Pankey *et al.*, 1985; Rainard & Poutrel, 1988).

It is concluded that infusion of antibiotics into the mammary gland of dairy goats at the end of lactation results in an increased cure rate of existing infections and a reduction in new infection rate. Hence dry-goat therapy is a useful tool for managing milk quality in dairy goats.

FIGURE 1. New intramammary infection rate (% glands newly infected) over the non-lactation period in glands from dairy goats defined as uninfected or infected before drying-off and treated or not treated at the end of lactation with intramammary antibiotics.



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