

The efficacy of intramammary, systemic and combined antibiotics administered during dry off in cows with subclinical mastitis*

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Summary: Eighty Brown Swiss cows were randomly assigned to three different therapy groups and a control group each including 20 cows to compare the efficacy of intramammary, systemic and intramammary plus systemic dry cow therapies in the elimination of existing subclinical intramammary infections (IMI) and prevention of new infections occurring in the dry period. Individual quarter milk samples were taken for microbiological isolation and identification from all cows prior to drying off and without regarding the results, the treatments were administered. Rates of elimination and prevention of IMI and for intramammary and combined therapy group were higher than systemic therapy group. Systemic therapy alone did not provide better results than the control group where no administration were done. The intramammary dry cow product used in this study seems effective in preventing new IMI and eliminating existing IMI. Better results were obtained in the combination therapy group while systemic dry cow therapy alone did not provide effective results in the prevention and elimination of IMI in the dry period.

Key words: Cow, dry cow therapy, prevention, subclinical mastitis.

Kuruya çıkartılan ineklerde subklinik mastitislerin önlenmesinde ve sağaltımında meme içi, sistemik ve kombine antibiyotik uygulamalarının etkinlikleri

Özet: Bu çalışmada 80 İsviçre Esmeri inek kullanılmış, bu inekler meme içi, sistemik, sistemik - meme içi kombine ve kontrol grubu olmak üzere 20' şer inekten oluşan dört farklı kuru dönem sağaltımı grubuna ayrılarak var olan subklinik meme enfeksiyonlarını tedavi edici ve koruyucu etkinlikleri karşılaştırılmıştır. Kuru döneme girişte tüm ineklerin her bir meme lobundan ayrı ayrı bireysel süt örnekleri alınarak, mikrobiyolojik izolasyon ve identifikasyon yapılmış, sonuçlara bakılmadan, sağaltımlar uygulanmıştır. Elde edilen sonuçlara göre meme içi ve kombine sağaltım gruplarında kuru dönem sürecinde daha yüksek iyileşme ve koruma oranları elde edilmiştir. Yalnız sistemik sağaltım grubunda hiçbir uygulama yapılmayan kontrol grubuna göre herhangi bir avantaj sağlanamamıştır. Sonuç olarak bu çalışmada kullanılan kuru dönem preparatının var olan enfeksiyonların sağaltımında ve yeni meme içi enfeksiyonların önlenmesinde etkin bir şekilde kullanılabileceği anlaşılmıştır. Kombine sağaltım daha iyi sağaltım oranı elde edilirken, tek başına sistemik sağaltım kuru dönemde meme içi enfeksiyonların sağaltımında ve korumada yeterli etkinlik oluşturmadığı görülmüştür.

Anahtar sözcükler: İnek, koruma, kuru dönem sağaltımı, subklinik mastitisler.

Introduction

Controlling mastitis in dairy herds is a combination of improving management, nutrition and environment factors, establishing proper milking system and using correct milking procedures while monitoring the health status of the mammary gland continuously (16). Culling the chronically infected cows, curing clinical mastitis cases with effective antibiotics during lactation, dry cow therapy and spontaneous cure during the dry period are the other components of mastitis control programs (15). Broad spectrum antibiotics administered in the beginning of the dry period prevents new IMI and significantly increases the cure rate of existing IMI compared to lactation period (5,7,13,18).

Researchers have indicated that effective dry cow therapy enables the cure of 50 to 98 % of existing IMI,

depending on the pathogen type (2,7,10,16). The factors that makes dry cow therapy a valuable tool for elimination of mastitis pathogens are the reduction of dilution of antibiotics in the mammary gland after intramammary infusion, better distribution of drugs due to the involution of the gland and reduction in the loss of milk due to the antibiotic residues (8,12).

In the beginning of the dry period with the cessation of milk flow various microorganisms existing in the teat skin and teat end gains the opportunity to colonize in the teat cistern. Mainly Staphylococcal and Streptococcal microorganisms are found here but the mammary gland is also exposed to environmental microorganisms in the dry period. *Fecal Streptococci*, *Klebsiella*, and *Enterobacteriaceae* spp. causes IMI mainly during early dry period while *E. coli* infections occur right after

* Aynı isimli doktora tez çalışmasından İngilizce olarak özetlenmiştir.

parturition (6). It was stated that dry cow therapy reduces the incidence of new infections 50 to 75 % (16).

Administration of single dose broad spectrum intramammary products is the traditional form of dry cow therapy. It was observed that cure rates with intramammary therapy is reduced especially in herds encountering chronic *Staphylococcus aureus* mastitis as a herd problem (9,20). Dry cow therapy studies have been focused on the eradication of this microorganism lately (8).

In a number of these studies besides intramammary therapy systemic and combined antibiotic therapy were administered during drying off. Tetracyclines, sulphonamide-trimetoprim (TMP), macrolides, lincosamides and some fluoroquinolones were administered via the systemic route (2,7,9,11,20).

The purpose of this study was to compare the efficacy of systemic and combined antibiotic therapies with intramammary administrations on the reduction of new infections and the cure of existing intramammary infections.

Materials and Methods

The animals used in this study were obtained from Çifteler state farm. Eighty Brown Swiss cows at the end of lactation period were chosen among 300 lactating cows regarding the AI records. All the animals were kept in closed barns and fed with corn silage and concentrate. The cows were dried off using the intermittent milking with reduction of concentrate. Milk samples were taken for bacteriological isolation and identification before drying off, the cows were then divided into four groups and following administrations were done regardless of the laboratory results.

Group I. (n=20): One dose of dry cow product including oxacillin was administered intramammary into all of the quarters (Stapenor Retard ©, benzathine oxacillin equal to 800 mg oxacillin, oxacillin sodium monohydrate equal to 200 mg oxacillin, Bayer).

Group II. (n=20): Following the last milking at dry-off enrofloxacin (Baytril, % 10 inj. sol. ©, Bayer) at a dose of 2.5 mg/kg via intramuscular route were administered to all cows.

Group III. (n=20): A combination of both above intramammary and intramuscular antibiotic administrations were used.

Group IV. (n=20): No treatment applied to this group.

Milk samples were obtained from all cows at seventh day following parturition. The main criteria for detection of subclinical mastitis in cows were bacteriological test results. Cows that had no observable mastitis symptoms in milk or mammary lobes while one or more quarters detected as infected with mastitis pathogens were classified as having subclinical mastitis. The absence of the same bacteria at sampling seven days following parturition were interpreted as a bacteriological cure otherwise in the presence of the bacteria the mammary quarter remained uncured. The quarters that remained uninfected during the dry period were detected also and the percentage of these cows recorded as prevention rate of dry cow therapy. The cows that had IMI in one or more quarters were classified as infected cows while cure and prevention rates on the cow basis during the dry period were reported in order to indicate the implication of dry cow therapy on pathogen reservoir in the herd.

Results

Various mastitis pathogens were isolated from 59 of 80 (73.75 %) cows in the herd. The occurrence rates of these pathogens to all mammary quarters and infected mammary quarters were shown in Table 1.

The cure and prevention rates of both cow and quarter basis were shown on Table 2. The cure rate on the cow basis in Group I were 65 % while the prevention and the cure rates of the therapy were 100 % and 86.8 % respectively. In Group II systemic enrofloxacin cured mastitis in 20 % of the cows while the preventive and cure rates on the mammary lobes were 91.3 % and 47.05 % respectively. In Group III cow cure rate, quarter prevention and cure rates were 75 %, 98.07 % and 89.28 % respectively. In the control group 75 % of uninfected cows and 86.27 % of uninfected quarters remained the same while the spontaneous cure rate for cow and quarter were 8.3 % and 55.17 %.

Table 1. Microorganisms detected in infected mammary quarters before drying off

Bacteria	Total number of isolated quarters	Rate of occurrence to total number of quarters (%)	Rate of occurrence to total number of infected quarters (%)
<i>S. aureus</i>	49	49/320 (15.31)	49/152 (32.23)
<i>S. agalactiae</i>	5	5/320 (1.56)	5/152 (3.28)
<i>Streptococcus</i> spp.	3	3/320 (0.93)	3/152 (1.97)
<i>Coagulase negative Staphylococci</i>	3	3/320 (0.93)	3/152 (1.97)
<i>A. pyogenes</i>	3	3/320 (0.93)	3/152 (1.97)
<i>Corynebacterium</i> spp	83	83/320 (25.93)	83/152 (54.60)
<i>Bacillus</i> spp.	8	8/320 (2.5)	8/152 (5.26)
<i>Coliform</i>	2	2/320 (0.62)	2/152 (1.31)

Table 2. The prevention and cure rates of different therapies on the cow and quarter basis

	Group	N	Infected cows / quarters (%)	Prevention rate (%)	Cure rate (%)
Cow	I	20	20 (100)	-	65
	II	20	15 (75)	100	20
	III	20	12 (60)	100	75
	Control	20	12 (60)	75 *	8.3 **
Quarter	I	80	61 (76.25)	100	86.8
	II	80	34 (42.5)	91.3	47.05
	III	80	28 (35)	98.07	89.28
	Control	80	29 (36.25)	86.27 *	55.17 **

*Cows or quarters remained uninfected during the dry period.

** Spontaneous cure rates.

Table 3. Clearance rates of various mastitis pathogens from the infected quarters

Pathogens	Group I		Group II		Group III		Control	
	Cure	New infection	Cure	New infection	Cure	New infection	Cure	New infection
<i>S. aureus</i>	2/2	2	6/18	10	20/20	-	2/9	6
<i>S. agalactiae</i>	-	2	4/4	-	1/1	-	-	-
<i>Streptococcus</i> spp	-	-	1/1	-	1/1	-	1/1	1
<i>Coagulase negative Staphylococci</i>	-	-	-	-	3/3	-	-	1
<i>A. pyogenes</i>	-	-	-	-	1/1	1	2/2	0
<i>Corynebacterium</i> spp	54/58	1	13/13	-	1/1	3	10/10	1
<i>Bacillus</i> spp.	-	-	-	-	-	-	5/8	0
<i>Coliform</i>	1/1	-	-	-	1/1	-	-	1
Total*	57/61	5	24/36	10	28/28	4	20/30	10

* Multiple pathogens were isolated from some of the quarters.

The effect of different dry cow therapies on various mastitis pathogens were shown in Table 3. In Group I the 93.1 % of *Corynebacterium* spp. infected quarters were cured. Also one coliform and two *S. aureus* IMI were cured by this therapy while five new infections occurred.

The cure rates of *S. aureus*, *Corynebacterium* spp., *S. agalactiae* and *Streptococcus* spp. infected quarters in cows treated with systemic enrofloxacin were 33.3 %, 100 %, 100 and 100 % respectively and 10 new *S. aureus* infections occurred.

In the combined therapy group all of the existing infections were cured and four new quarters infected during the dry period (Three infected with *Corynebacterium* spp. and 1 with *A. pyogenes*).

In the control group spontaneous cure rates for *S. aureus*, *Streptococcus* spp., *A. pyogenes*, *Corynebacterium* spp. and *Bacillus* spp. were 22.22 %, 100 %, 100 %, 100 and 62.5 % and 10 new infections occurred.

Discussion

In this study intramammary infections were observed in 59 of 80 (73.75 %) cows. The 152 of 320 (47.5 %) quarters of these cows were infected with various pathogens. The incidence of intramammary infections are higher than in most of the previous studies where the scores are between 7.7 % - 35 % on the quarter basis (2,14). The type and incidence of microorganisms encountered in dry cow therapy studies are affected by

factors like age, environment, season and management (8). A high proportion of cows were infected with *Corynebacterium* spp. in this study and these are mainly consisted of *C. bovis* especially in Group I, II and III with a total of 54.60 % of all of the mammary quarters. Smith and Hogan (19) have stated that failure to apply post milking teat dipping in cows may increase the prevalence of this microorganism over 50 % in the herd. A similar trend in *Corynebacterium* spp. have been reported by Costa et al. (4) with a rate of 76.98 % in quarters of all cows in the herd.

Staphylococcus aureus is the obligate pathogen of the mammary tissue which causes mainly subclinical mastitis which main sources of infection are the quarters of infected cows. The microorganism is resistant to most of the antibiotics (3) and after the infection is clinically cured it resides in the self-formed microabscesses in capsulated form which causes the infection to turn into subclinical form (1). Many studies have been carried out for the elimination of *S. aureus* in the dry period (7,11,19). The second prevalent microorganism in the herd was *S. aureus* with a rate of 15.31 % of all quarters. Batra et al. (2) have detected this microorganism in 75 %, and Costa et al. (4) in 26.98 % of infected mammary quarters.

Oxacillin is resistant to penicillinase producing microorganisms. When administered alone like in Group I the therapeutic and preventive effect of the drug was

proven. Similar results have been obtained in various studies where drugs of the same group were used (3,4,5,12).

In Group II a limited therapeutic effect on microorganisms other than *S. aureus* have been observed while the overall prevention and cure rates remained low compared to the other therapy groups. Moreover spontaneous cure rate of control group on the quarter basis was even higher than this group. The results were in accordance with some of the workers' (8,17) while others (11,19) obtained better efficacy with systemic dry cow therapy. Reasons for this variance may be the sensitivity of the microorganism to the drug or the ability of the drug to distribute well in the mammary tissue and reach optimal inhibitory concentrations.

In Group III it was remarkable that all of the existing *S. aureus* infections were eliminated. In dry cow therapy trials monitoring the spontaneous cure rates as well as drug therapy during the dry period is essential because concerning *S. aureus* it was observed that, 25-38 % of the total cure which is about 63-68 % is spontaneous (14). In this study reduction in the number of IMI during the dry period were also observed. In 55.17 % of quarters spontaneous cure were observed while new infections occurred in six of the uninfected quarters.

Regarding these findings, intramammary oxacillin can be used effectively to cure subclinical IMI in the dry period. The cure rates obtained by this drug is equivalent or higher than cure rates obtained by similar drugs.

In this study the highest cure and prevention rates were obtained in Group I and III while combined therapy was more effective in the elimination of existing *S. aureus* infections. In the scope of these results it can be said that systemic antibiotics may potentiate the effect of dry cow therapy and this can be cost-effective especially in herds where subclinical mastitis is a chronic problem.

Acknowledgements: The researchers would like to thank to Çifteler State Farm and Bayer Türk veterinary drug company for their support to this study.

References

1. **Ali-Vehmas T, Sandholm M** (1995): *Balance between bacteria and host-the bacteria's point of view.* 49 – 58. In: M Sandholm, T Honkanen-Buzalski, L Kaartinen, S Pyörälä (Eds) *The Bovine Udder and Mastitis*. Gummerus Kirjapaino oy, Jyväskylä, Finland.
2. **Batra TR** (1988): *Effects of a complete dry cow treatment on mastitis control in dairy cattle.* *Can J Anim Sci*, **68**, 553-556.
3. **Buddle BM, Hecceg M, Ralston MJ, Pulford HD** (1987): *Reinfection of bovine mammary glands following dry-cow antibiotic therapy.* *Vet Microbiol*, **15**, 191-199.
4. **Costa EO, Ribeiro AR, Watanabe ET, Sâ R, Silva JA, Garino Jr F** (1996): *Evaluation of dry cow treatment on bovine mastitis: Cure rate and new infection rate.* *Proceedings of the XIX World Buiatrics Cong.*, Vol 1, Edinburgh 193 - 195.
5. **Davidson TJ, Dohoo IR, Donald AW** (1994): *Comparing two dry cow treatments on the new infection and elimination rates of coagulase negative staphylococci.* *Can Vet J*, **35**, 775 - 776.
6. **Eberhart RJ** (1986): *Management of dry cows to reduce mastitis.* *J Dairy Sci*, **69**, 1721 - 1732.
7. **Erskine RJ, Bartlett PC, Crawshaw PC, Gombas DM** (1994): *Efficacy of intramuscular oxytetracycline as a dry cow treatment for Staphylococcus aureus mastitis.* *J Dairy Sci*, **77**, 3347 - 3353.
8. **Funk DA, Freeman AE, Berger PJ** (1982): *Environmental and physiological factors affecting mastitis at drying off and postcalving.* *J Dairy Sci*, **65**, 1258 - 1268.
9. **Johansson T, Funke H, Emanuelson U** (1995): *Systemic treatment of chronic subclinical Staphylococcus aureus mastitis at drying-off.* *Proceedings of the third IDF International Mastitis Seminar, Vol-2, Tel-Aviv, Session 5*, 54-57.
10. **Kirk JH** (1991): *Diagnosis and treatment of difficult mastitis cases, Part 1: Staphylococcus and Pseudomonas.* *Agri-Practice*, **12**, 5-8.
11. **Marco JC, Escobal I, Gonzalez L, Aduriz JJ** (1996): *Efficacy of enrofloxacin during the dry period against mastitis caused by Staphylococcus aureus in dairy cattle.* *Proceedings of the XIX World Buiatrics Cong. Vol 1*, Edinburgh, 223 - 225.
12. **McKellar QA** (1991): *Intramammary treatment of mastitis in cows.* *In Practice*, November, 244-249.
13. **Nickerson SC, Owens WE, Fox KL, Scheifinger CC, Shryock TR, Spike TE** (1999): *Comparison of tilmicosin and cephalirin as therapeutics for Staphylococcus aureus at dry-off.* *J Dairy Sci*, **82**, 696 - 703.
14. **Østeras O, Edge VL, Martin SW** (1999): *Determinants of success or failure in the elimination of major mastitis pathogens in selective dry cow therapy.* *J Dairy Sci.*, **82**, 1221 - 1231.
15. **Philpot WN, Nickerson SC** (1994): *Mastitis Counter Attack*, Babson Bros. Co., Illinois.
16. **Radostits OM, Leslie KE, Fetrow J** (1994): *Mastitis control in dairy herds.* 229-273. In: OM Radostits, KE Leslie, J Fetrow (Eds), *Herd Health 2nd Ed.* W.B. Saunders Company, Philadelphia .
17. **Saran A, Soback S, Faingold D, Ziv G, Winkler M, Glickman A** (1995): *Systemic v.s. intramammary dry - cow treatment.* *Proceedings of the third IDF International Mastitis Seminar, Vol-2, Tel-Aviv, Session 5*, 34-38.
18. **Schultze WD** (1983): *Antibiotic formulations for drying off therapy of dairy cattle.* *Dairy Food & San*, **6**, 215-218.
19. **Smith KL, Hogan JS** (1995): *Epidemiology of mastitis.* *Proceedings of the third IDF International Mastitis Seminar, Vol-2, Tel-Aviv, Session 6*, 3-12
20. **Smith KL, Todhunter DA, Schoenberger PS.** (1985): *Environmental pathogens and intramammary infection during the dry period.* *J Dairy Sci*, **68**, 402-417.

Geliş tarihi: 05.01.2006 / Kabul tarihi: 20.02.2006

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