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Effects of an Automatic Postmilking Teat Dipping System on New Intramammary Infections and Iodine in Milk

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ABSTRACT

A technology of automatically applying a postmilking teat dip via the milking machine prior to machine detachment was compared to manual postmilking teat dipping with a teat dip cup for effects on new IMI and iodine content in milk. One hundred twenty Holstein cows were experimentally challenged in a 22-wk trial with *Streptococcus agalactiae* and *Staphylococcus aureus* and 148 Holstein cows were experimentally challenged with *Streptococcus uberis* in another 22-wk trial. The bacterial suspensions were applied to teats of all of the cows after premilking udder preparation and immediately prior to milking machine attachment. In both trials, cows were divided among four treatments: no postmilking teat dipping; manual postmilking teat dipping with a proven efficacious iodophor teat dip; manual postmilking teat dipping with an iodophor teat dip formulated for an automatic postmilking teat dipping system; and automatically postmilking teat dipping via milking machines with an iodophor teat dip formulated for the automatic postmilking teat dipping system. The postmilking teat dipping treatments reduced new *Staph. aureus* IMI by 64.5, 76.5, and 88.2%; new *Strep. agalactiae* IMI by 61.5, 77.8, and 94.4%; and new *Strep. uberis* IMI by 63.5, 82.5, and 93.8%, respectively, against the treatment of no postmilking teat dipping. The treatment applying the postmilking teat dip automatically via milking machines had the lowest number of new IMI caused by the three pathogens. Teat end and teat skin condition were characterized as normal at the end of the study with no differences between treatments. There were no differences with regard to iodine content in milk between treatments.
(**Key words:** postmilking teat dipping, mastitis, milking system)

Abbreviation key: ATCC = American Type Culture Collection, **TSA** = trypticase soy agar, **TSB** = trypticase soy both.

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INTRODUCTION

Efficacy of postmilking teat dipping has been well established and widely accepted as a milking practice in controlling new IMI (Natzke et al., 1972; Pankey et al., 1984). Approximately 10% of the total worker routine time during milking is spent dipping teats with a teat germicide after each milking (Armstrong, 1991). With the emphasis on efficiency and performance of milking procedures and milking systems, milking technologies continue to be developed to increase labor efficiency and performance of milking (Smith, 2003).

An automatic postmilking teat dipping technology via the milking machine has been developed (Westfalia Surge Air Dip Technology, Westfalia Surge, Inc., Naperville, IL) to reduce the milking work routine time by replacing manual postmilking teat dipping with automation and to consistently apply the postmilking teat dip to all teats prior to machine removal. The automatic postmilking teat dipping system applies a teat dip that was formulated for the new technology prior to machine removal, with subsequent flushing of liners after machine removal. When a cow is finished milking, the detacher unit sends a signal to the system's control to begin the postmilking teat dipping cycle. A teat dip injector is positioned in the short milk tube, just underneath the teat cup shell which closes the short milk tube completely via the use of a piston; this piston then sprays approximately 3 to 4 ml of teat dip with a 1- to 2-s blast of air towards the teat while the milking machine is attached and the liners are pulsating. The detacher unit retracts the milking unit to the detached position. The cycle pauses for 7 to 10 s after removal of milking machine, allowing the teat dip to kill bacteria on the liner surface. After this delay, the cycle continues as the injector sprays water for 1 to 2 s, then with air for 1 to 3 s, repeating for a minimum of 6 times through the liner to rinse the teat dip residue out of the liner. This time interval allows any residual dip to drain out of the liner through the injector drain port in case the liner is inadvertently held in an upright position. Then the piston returns to the milking position and is followed by an internal rinsing of the injector air break cavity, repeating with 1 s of water, then 1 s of air for

3 times. The total time to complete the cycle is 30 to 40 s. The cycle is controlled at each stall by an individual control. Each stall control operates independently of the other stall controls. Pressurized dip, water, and air are supplied to each one of these individual controls by a main control pump panel. The main control panel creates and monitors the system pressures.

Trials were conducted to determine the efficacy of an automatic postmilking teat dipping system (Westfalia Surge Air Dip Technology) applied at the end of milking on the number of new IMI and iodine content in milk.

MATERIALS AND METHODS

Trial 1

Cows. One hundred twenty Holstein cows were used in a 22-wk controlled infection trial to evaluate the efficacy of an automatic postmilking teat dip system with an experimental challenge of *Streptococcus agalactiae* and *Staphylococcus aureus*. A split herd design was used where cows were assigned to treatments. Cows were identified manually in the milking parlor for application of treatment. Cows were housed in a free-stall facility, bedded with hardwood shavings, and milked in a double-10 herringbone parlor with a low milk line.

Treatments

During the afternoon milking, Monday through Friday, for the 22-wk trial all teats of every cow were immersed to a depth of approximately 25 mm in a challenge suspension containing approximately 5×10^7 cfu of *Strep. agalactiae* [**ATCC** 27956, Rockville, MD)] and 5×10^7 cfu of *Staph. aureus* (ATCC 29740). The bacterial challenge was applied immediately after premilking udder preparation and prior to application of the milking units. The bacterial challenge was used to simulate contamination of the teats and subsequent contamination of the milking units with mastitis pathogens to determine the efficacy of the automatic postmilking teat dip technology that was applied at the end of milking via milking machines. Premilking udder preparation consisted of fore-stripping of 2 to 3 streams of milk and application of premilking teat dip with contact time of 20 to 30 s with subsequent drying of the teats with cloth towels.

Treatments were: 1) no postmilking teat dipping: no teat dipping occurred after milking (negative control); 2) positive control: postmilking teat dipping occurred with a proven efficacious teat dip (Nickerson, et al., 1986) (0.5% titratable iodine with a 2% emollient system; formulated for manual dipping) applied manually with a teat dip cup; 3) Air Dip manually applied: postmilkingteat dip (AirDyne 5000, 0.5% titratable iodine with 5% quadruple emollient; formulated for automation application) was applied manually with a teat dip cup; and 4) Air Dip automatically applied: postmilking teat dip (AirDyne 5000, 0.5% titratable iodine with a 5% quadruple emollient; formulated for automation application) was applied by an automatic postmilking teat dipping system prior to machine detachment.

Sampling Schedule

The bacteriological status of each mammary quarter was determined within 1 wk before the experiment started. Duplicate quarter milk samples were taken aseptically and cultured weekly (Monday a.m.) to determine the bacteriological status of each quarter. A third sample was collected on Thursday a.m. and cultured when results of the first two samples differed. Duplicate quarter milk samples were collected and cultured from any identified case of clinical mastitis. All quarter milk samples were collected aseptically and analyzed each week by procedures recommended by National Mastitis Council (Hogan et al., 1990). When *Strep. agalactiae* or *Staph. aureus* were cultured in the weekly duplicate quarter milk samples, a new IMI was confirmed. All quarters were eligible for one new IMI caused by *Strep. agalactiae* or *Staph. aureus*; with all infected quarters removed from further sampling and analysis.

Collection of Milk Samples

Before quarter milk sampling, the ventral surfaces of udders and teats that were excessively dirty were washed using a hand-held hose and paper towels. After washing, udders and teats were dried thoroughly with additional paper towels, and 2 or 3 streams of foremilk were discarded. Each teat apex was scrubbed for several seconds with a cotton pledget moistened with 70% alcohol until it was thoroughly clean. Teats on the side of the udder opposites from the technician were sanitized first, and milk samples were collected in reverse order into sterile snap-cap plastic tubes and refrigerated at 5°C. For teats that were visibly clean before collection, washing was omitted, and only cotton pledgets moistened with 70% alcohol were used to sanitize teat ends.

Culture and Diagnostic Procedures

Milk samples were mixed by shaking and a 0.01-mL aliquot was streaked on trypticase soy agar (**TSA**; Becton Dickinson, Cockeysville, MD) containing 5% bovine calf blood. Plates were incubated at 37°C for 48 h and examined to identify the microorganisms that were present. Contaminated quarters were resampled to confirm the presence or absence of challenge organisms.

Colonies of *Staph. aureus* were identified by hemolytic pattern and confirmed by the tube coagulase test. Colonies of *Strep. agalactiae* were identified to serogroup by the Phadebact Streptococcus Test (Boule Diagnostics AB, Huddinge, Sweden). A new IMI was confirmed when 1) *Staph. aureus* or *Strep. agalactiae* were isolated from a clinical quarter, 2) two consecutive samples yielded ≥500 cfu/mL of the same pathogen, or 3) three consecutive samples contained 100 to 400 cfu/mL of the same pathogen (Hogan et al., 1990).

Preparation of the Challenge Suspension

Suspensions of *Staph. aureus* and *Strep. agalactiae* were prepared as described by Boddie et al. (1994). Stock suspensions were prepared weekly. The contents of a lyophilized vial of *Staph. aureus* were reconstituted in 6 mL of trypticase soy broth (**TSB**; Becton Dickinson) and incubated at 37°C for 5 to 7 h. This culture was used to inoculate a 500-mL volume of TSB, which was incubated on a gyratory shaker for 16 h. After incubation, bacterial cells were pelleted by centrifugation, washed twice with 0.1% proteose-peptone, and 0.1 mL was plated on TSA with 5% bovine calf blood. Plates were incubated for 24 h at 37°C, and colonies were counted to ascertain the microbial concentration of the stock suspension. This suspension was stored at 5°C and was used daily for 5 d to prepare challenge suspensions of *Staph. aureus*.

Cultures of *Strep. agalactiae* were prepared by suspension of a lyophilized vial of *Strep. agalactiae* in 6 mL of TSB, and a 0.01-mL aliquot was streak-plated on each of 5 TSA plates. Plates were incubated at 37°C for 16 h and stored at 5°C to serve as stock cultures for 5 d. Daily suspensions of *Strep. agalactiae* were prepared by the inoculation of 6 mL of TSB with 6 colonies from a TSA stock plate. The 6-mL culture was incubated for approximately 15 h at 37°C and was used to inoculate 500 mL of TSB. The 500-mL culture was incubated for 7 h at 37°C on a gyratory shaker. Aliquots of the culture were added to approximately 150-mL of nonsterile pasteurized milk to adjust the concentration of *Strep. agalactiae* to approximately 5×10^7 cfu/mL.

An aliquot of the *Staph. aureus* stock suspension was added to the *Strep. agalactiae* suspension to obtain a concentration of approximately 5×10^7 cfu/mL of *Staph. aureus*. A plate count was conducted daily on challenge suspensions.

Scoring of Teat Skin and Teat End Condition

Characteristics of lateral teat skin surfaces and those of teat ends were scored immediately before the initiation of the teat dip trial and at the conclusion of the trial to determine and effects of the germicide on teat condition. Condition scores for the lateral teat skin were on a 6-point scale where 0 = teat skin that had been subjected to physical injury not related treatment and 5 = teat skin that had been severely damaged with scabs or lesions (Goldberg et al., 1994). Condition scores for teat ends were also recorded on a 6-point scale where 0 = teat had been subjected to physical injury not related to treatment and 5 = teat end was severely damaged and ulcerative with scabs or warts (Goldberg et al., 1994).

Statistical Methods

Differences between the percentages of quarters that became infected in treatment groups were tested as described by (Hogan et al., 1990) using an approximated t statistic defined as follows: $t = [(x_1/n_1) - (x_2/n_2)][(x_1 + x_2)/(n_1n_2)]^{0.5}$, where x_1 = number of new IMI in control quarters, x_2 = number of new IMI in treated quarters, n_1 = (number of control quarters) (time unit), and n_2 = (number of treated quarters) (time unit). The denominations n_1 and n_2 were expressed as the sum of quarter-days. A quarter was eligible for only one IMI per organism during the study. The percentage reduction in rate of new IMI in the treated group compared with that in the control group was expressed as $100[(x_1/n_1) - (x_2/n_2)]x_1/n_1)$. Teat dips generally are considered to be effective when the mean percentage reduction of new IMI is ≥40% and the lower confidence limit of the mean is ≥25% reduction (Hogan et al., 1990).

Condition scores of teat skin and teat ends before and after the study were analyzed by repeated measures AVOVA. The design was a split block in time adapted from Gill and Hafs (1971) using the following model: $Y_{ijk} = \mu + A_i + B(A)_j + C_k + AC_{ik} + e_{ijk}$, where Y_{ijk} = dependent observation, μ = overall mean, A_i = teat dip I, $B(A)_j$ = cow j nested within teat dip, C_k = time k (before or after study), AC_{ik} = interaction of teat dip and time, and e_{ijk} = residual error. The effect of teat dip was tested using $B(A)_j$ as the error term $\alpha < 0.05$ probability of a Type 1 error as the criterion for rejecting the null hypothesis of no difference. Time and the interaction of teat dip and time were tested using the residual as the error term. If a significant interaction was detected, the effects of the teat dip were examined within time by general linear models ANOVA.

Trial 2

The protocol for trial 2 was as stated for trial 1 except for the following:

Cows. One hundred forty-eight Holstein cows were used in a 22-wk controlled infection experiment to eval-

Table 1. Summary of efficacy data of an automatic post milking teat dipping system (Westfalia Surge Air Dip Technology) against new IMI of *Staphylococcus aureus* and *Streptococcus agalactiae*. Treatment 1 = no postmilking teat dipping (negative control), treatment 2 = positive control: proven efficacious postmilking teat dip applied manually, treatment 3 = Air Dip manually applied: postmilking teat dip (AirDyne 5000) applied manually, and treatment 4 = Air Dip automatically applied: postmilking teat dip (AirDyne 5000) applied by an automatic postmilking teat dipping system (Westfalia Surge Air Dip Technology).

	Quarters eligible for new IMI	New IMI	Quarter-days at risk for new IMI	New IMI per 100 Quarter-days at risk	Reduction	
	(no.)				(%)	
Staph. aureus						
Treatments						
1	120	41	13,688	0.299		
2	120	16	15,010	0.106	64.5[1]	
3	120	11	15,642	0.070	76.5[1]	
4	120	6	16,922	0.035	88.2[1]	66.9[2]
Strep. agalactiae						
Treatments						
1	120	43	14,008	0.307		
2	120	18	15,211	0.118	61.5[1]	
3	120	11	15,988	0.068	77.8[1]	
4	120	3	17,411	0.017	94.4[1]	85.5[2]

[1]Number of new infections significantly reduced ($P < 0.05$) from Treatment 1.

[2]Number of new infections significantly reduced ($P < 0.05$) from Treatment 2.

uate the efficacy of the automatic postmilking teat dipping system with an experimental challenge of *Strep. uberis*.

Preparation of challenge suspension. *Streptococcus uberis* (ATCC 27958) was the experimental challenge organism. A transfer of the challenge organism was taken from an agar slant stock culture and streaked on a tryptose blood agar esculin plate and incubated for 16 h at 37°C. From the seed plate, 2 mL of trypticase soy broth were inoculated and incubated for 75 min at 37°C. This was added to 200 mL of Todd-Hewitt broth and incubated until 350×10^6 cfu/mL was obtained. Standardized stock cultures were dispensed in 1-mL aliquots and stored at –20°C. For each daily challenge, 1 mL of stock culture was used to inoculate 400 mL of Todd-Hewitt broth, which was then incubated at 37°C for 6 h with intermittent mixing. Average concentration of the bacterial suspension was 5×10^7 cfu/mL.

Trial 3

This trial was designed as a split herd study to determine the effects of the automatic postmilking teat dipping system using an iodophor postmilking teat dip (AirDyne 5000 0.5% titratable iodine with 5% quadruple emollient) on iodine content in milk compared to the manual application of the teat dip with a teat dip cup. Each milking unit in the herringbone parlor was equipped with the automatic postmilking teat dipping system.

The 10-wk period was divided into three periods: 2-wk pretreatment; 6-wk treatment; and 2-wk posttreatment. Throughout the study, udder preparation consisted of cleaning the teats with wet paper towels containing a chlorine-based udder wash sanitizer with subsequent drying with dry paper towels. During the experiment, cows were fed the same TMR, and no free choice trace minerals were fed.

One hundred cows were assigned to 1 of 5 treatments: 1) no teat dipping occurred prior to or after milking during the 3 treatment periods (negative control); 2) postmilking teat dipping was applied manually during the treatment period with a teat dip cup, no postmilking teat dipping occurred during the pre- and posttreatment periods; 3) postmilking teat dipping was applied manually during both of the treatment and posttreatment periods with a teat dip cup, no postmilking teat dipping occurred during the pretreatment period; 4) postmilking teat dipping was applied with the automatic postmilking teat dip technology during the treatment period, no postmilking teat dipping occurred during the pre- and postmilking periods; and 5) postmilking teat dipping was applied with the automatic postmilking teat dipping technology during both treatment and posttreatment periods, no postmilking teat dipping occurred during the pretreatment period. Cows within treatments were milked with the same milking units and the cows were identified manually for application of treatment.

Samples of each cow's composite milk were collected during the last 3 d (p.m. milking) of each week of the

Table 2. Summary of efficacy data of an automatic postmilking teat dipping system (Westfalia Surge Air Dip Technology) against new IMI of *Streptococcus uberis*. Treatment 1 = no postmilking teat dipping (negative control), treatment 2 = positive control: proven efficacious postmilking teat dip applied manually, treatment 3 = Air Dip manually applied: postmilking teat dip (AirDyne 5000) applied manually, and treatment 4 = Air Dip automatically applied: postmilking teat dip (AirDyne 5000) applied by an automatic postmilking teat dipping system (Westfalia Surge Air-dip Technology).

	Quarters eligible for new IMI	New IMI	Quarter-days at risk for new IMI	New IMI per 100 quarter-days at risk	Reduction		
	(no.)				(%)		
Strep. uberis Treatments							
1	148	56	12,220	0.458			
2	148	31	18,485	0.167	63.5[1]		
3	148	16	20,002	0.080	82.5[1]		
4	148	6	20,911	0.028	93.8[1]	83.2[2]	65.0[3]

[1]Number of new infections significantly reduced ($P < 0.05$) from Treatment 1.
[2]Number of new infections significantly reduced ($P < 0.05$) from Treatment 2.
[3]Number of new infections significantly reduced ($P < 0.05$) from Treatment 3.

study using DHI milk sampling procedures. Iodide specific ion electrode was used to measure iodine concentration in the milk (Craven et al., 1977).

Baseline milk iodine concentration was established for each cow by calculating the mean iodine by cow and treatment by week for the 3 periods of the experiment. The data during the treatment period were used to compare against the pretreatment data to determine the treatment response for iodine residue in milk. The posttreatment iodine data were used to determine any carryover effect of the treatments.

RESULTS AND DISCUSSION

Trials 1 and 2

The postmilking teat dip treatments (2, 3, 4) significantly reduced the number of new IMI caused by *Staph. aureus* compared with the negative control treatment (1) by 64.5, 76.5, and 88.2% ($P < 0.05$) and reduced the number of new IMI caused by *Strep. agalactiae* by 61.5, 77.8, and 94.4% ($P < 0.05$), respectively (Table 1). The infection rates for *Staph. aureus* in treatments 1, 2, 3, and 4 were 34.1, 13.3, 9.1, and 5.0%, respectively. Infection rates for *Strep. agalactiae* were 35.8, 15.0, 9.1, and 2.5% for treatments 1, 2, 3, and 4, respectively. Among the treatments (2, 3, 4) involving postmilking teat dipping, there was a significant reduction of new IMI between treatments 2 and 4 for *Staph. aureus* by 66.9% and for *Strep. agalactiae* by 85.5% ($P < 0.05$).

The postmilking teat dip treatments (2, 3, 4) significantly reduced the number of new IMI caused by *Strep. uberis* by 63.5, 82.5, and 93.8% ($P < 0.05$) for treatments 2, 3, and 4, respectively compared to the negative control treatment 1 (Table 2). The infection rates for *Strep. uberis* for treatment 1, 2, 3, and 4 were 37.8, 20.9, 10.8, and 4.0%, respectively. Among the treatments (2, 3, 4) involving postmilking teat dipping, there was a significant reduction of new IMI between treatments 2 and 4

Table 3. Mean condition scores of teat skin and teat ends before and after the evaluation of an automatic postmilking teat dipping system during a 22-wk infection trial (Westfalia Surge Air Dip Technology). Treatment means were not significantly different ($P > 0.05$).

	Teat skin[1]	Teat end[2]
Before trial Treatments		
1	1.09	1.13
2	1.08	1.14
3	1.11	1.10
4	1.07	1.10
After trial Treatments		
1	1.09	1.14
2	1.11	1.08
3	1.10	1.10
4	1.09	1.11

[1]Teat skin condition scoring (Goldberg et al., 1994); 0 = teat skin has been subjected to physical injury (e.g., stepped on or frostbitten) that is not related to the treatment, or the quarter is nonlactating; 1 = teat skin is smooth and free from scales, cracks, or chapping; 2 = teat skin shows some evidence of scaling; 3 = teat skin is chapped, and some small warts may be present; 4 = teat skin is chapped and cracked; redness, indicating inflammation, is present; and numerous warts may be present; and 5 = teat skin is severely damaged and ulcerative with scabs or open lesions; large or numerous warts are present that interfere with teat end function.

[2]Teat end condition scoring according to (Goldberg et al., 1994); 0 = teat end has been subjected to physical or chemical injury (e.g., stepped on or frostbitten) that is not related to the treatment, or the quarter is nonlactating; 1 = teat end sphincter is smooth with no evidence of irritation; 2 = teat end has a raised ring; 3 = teat end sphincter is roughened with slight cracks, but no redness is present; 4 = teat end sphincter is inverted with many cracks, giving a flowered appearance; and teat end may have old, but healing, scabs; and 5 = teat end is severely damaged and ulcerative with scabs or open lesions; large or numerous warts are present that interfere with teat end function.

Table 4. Experiment 3: Mean iodine content in milk for manual and automatic application of an iodophor postmilking teat dip. Postmilking iodophor teat dip used for all treatments—AirDyne 5000, 0.5% titratable iodine, formulated for Westfalia Surge Air Dip Technology, Westfalia Surge, Inc., Naperville, IL. Treatments: 1) no postmilking dipping, 2) postmilking teat dip applied manually during treatment period, 3) postmilking teat dip applied manually during treatment and posttreatment periods, 4) postmilking teat dip applied with an automatic postmilking teat dipping system (Westfalia Surge Air Dip Technology) during the treatment period, and 5) postmilking teat dipping applied with an automatic postmilking teat dipping system (Westfalia Surge Air Dip Technology) during treatment and posttreatment periods.

Treatments	Pre-treatment period	Treatment period	Post-treatment period	Difference[1,2]	Difference[3,2]
		μg/l			
1	220.5	217.3	217.0	3.2[a]	0.3[a]
2	223.0	251.6	226.5	28.6[b]	25.1[b]
3	217.5	249.3	246.5	31.8[b]	2.8[a]
4	216.0	247.5	218.5	31.5[b]	29.0[b]
5	220.0	247	247	27.0[b]	0[a]

[a,b]Means with different superscripts differ ($P < 0.01$).

[1]Differences of iodine residue between pre- and treatment periods.

[2]Standard error of mean ± 4.8.

[3]Differences of iodine residue between treatment and post-treatment periods.

for *Strep. uberis* by 83.2% and between treatments 3 and 4 for *Strep. uberis* by 65.0% ($P < 0.05$).

Automatically applying the postmilking teat dip via milking machines prior to machine removal reduced the number of new IMI caused by the 3 mastitis pathogens used in the experimental challenge compared with applying postmilking teat dip manually with a teat dip cup. This may be due to more consistent and effective application and teat skin coverage of the teat dip by the milking machine compared to manual application of the teat dip. There may be greater penetration of the teat dip of the teat canals since the teat dip was applied by an air blast while milking machines were attached. Earlier work (Newbould, 1970) indicated that mastitis pathogens could penetrate into the teat canals and are correlated with new IMI.

Mean scores of teat skin conditions before and after the experimental for all treatments ranged from 1.07 to 1.11 (Table 3). Analysis of condition scores for teat ends ranged from 1.08 to 1.14 (Table 3). No significant differences ($P > 0.05$) occurred among the 4 treatments for condition scores of teat skin and teat ends before and after the trial.

Trial 3

Iodine content in milk was significantly different ($P < 0.05$) between the no postmilking teat dipping treatment and the 4 treatments where postmilking teat dipping was applied during the treatment period (Table 4). The increase in iodine content in the milk associated with postmilking teat dipping ranged from 27.0 to 31.8 μg/L. These findings are similar to other studies (Galton et al., 1984, Galton et al., 1986). Among the 4 treatments consisting of postmilking teat dipping, no significant differences ($P > 0.05$) existed during the treatment period for iodine content in milk, suggesting there were no effects on iodine content in milk due to method of application (manual and automation) (Table 4). There was a significant difference ($P < 0.05$) between the treatments with postmilking teat dipping occurring only during the treatment period and the treatments with postmilking teat dipping occurring during both of the treatment and posttreatment periods (Table 4). The decrease in iodine content in milk in the posttreatment period associated with no postmilking teat dipping is in agreement with (Galton et al., 1984, 1986). There was no difference ($P > 0.05$%) for iodine content in milk between postmilking teat dipping being applied either manually with a teat dip cup or automatically via milking machines prior to machine detachment; suggesting that the back flushing of the milking machines after machine detachment was sufficient in removing iodine residue in the teat cups.

CONCLUSIONS

The data indicated the following conclusions: 1) new IMI were reduced with the use of an automatic postmilking teat dipping system that applied a teat dip specifically formulated for the system; 2) teat skin and teat ends were not affected by either applying the teat dip manually or automatically; and 3) iodine content in milk did not differ between manual and automatic application of an postmilking teat dip.

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