Milk Iodine Residues in Herds Practicing Iodophor Premilking Teat Disinfection

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ABSTRACT
The objective was to determine effects of different concentrations of iodophor teat dips on milk iodine residues, when teat dips were used both premilking and postmilking. Eighty cows in each of seven herds were assigned to one of four treatments. Each treatment received postmilking teat dip at .1 or 1% iodophor concentration. Two groups received no premilking dip, and the other two groups received premilking teat dip at the same concentration as the postmilking teat dip. Premilking teat dipping was followed by manual drying of teats. Noniodophor postmilking dips and no premilking iodophor udder sanitizers were used during an 8-d adjustment period. Milk was collected for milk iodine determination from each cow from weigh jars or milk meters at p.m. milkings during the last 3 d of the adjustment period and d 4, 6, and 8 of the treatment period. Premilking and postmilking teat dipping with .1% iodophor dip did not significantly increase milk iodine residue above postmilking teat dipping with .1% iodophor dip alone. However, 1% iodophor postmilking teat dip significantly increased milk iodine residue over use of .1% iodophor dip used as a premilking and postmilking teat dip. Adding a 1% iodophor premilking teat dip significantly increased iodine residues.

INTRODUCTION
During recent years, concerns have been expressed that the population of the United States might be exposed to more iodine in their diet than is necessary (1, 16, 22). Recommended dietary allowance for iodine is 150 µg/d for adults, 70 to 120 µg/d for children, and 40 to 50 µg/d for infants (3). A 1978 Food and Drug Administration survey (16) found that milk and dairy products contributed 56% of total food iodine intake for most age groups. Approximately 62% of New York dairy farms had iodine less than 200 µg/L in bulk tank milk, 28% between 200 and 499 µg/L, 7% between 500 and 1000 µg/L, and 3% greater than 1000 µg/L (7).

On-farm increase in concentration of iodine in milk has been attributed to supplemental iodine in dairy rations (5, 11, 13, 17), iodophor-containing sanitizers and postmilking teat dips (2, 10, 13, 18), and animal medications containing iodine (4, 8). Feed additives have been documented as the main factor contributing to iodine content in milk (5, 11, 17). Iodine content of milk is highly variable and is closely correlated with the amount consumed at normal intakes. At high feed intake, however, the correlation is no longer close. When calculated as percent of feed intake, the portion of iodine entering milk is reduced as feed intake increases (13).

Some work has shown that iodophor udder wash sanitizers do not lead to significant increases of iodine in milk (2), whereas other work showed increases of up to 35 µg/L (8, 12). Possible reasons for differences include type and concentration of iodophor sanitizers and methods of application (9). Iodophor postmilking teat dips have consistently increased iodine in milk (9, 14, 18). The magnitude of the increase varies among studies. Swedish studies concluded that the average increase of iodine was 174 µg/L (range of 55 to 353 µg/L) when a 1.6% iodophor teat dip was used, whereas milk iodine residue was 40 to 50% of this when an .8% iodophor teat dip was used (14, 15). Direct comparison of iodophor teat...
dips containing .75, .6, and .5% iodine resulted in milk iodine 130, 85, and 77 μg/L (20). Other studies have shown similar trends (9, 10, 18). A study using both control animals and a pre-treatment control period estimated an increase of 80 to 100 μg/L in iodine content in milk when a teat dip containing 1% iodine was used compared with a chlorine control (4). Physical properties of teat dip formulations also influence iodine content of milk (9). Increased iodine in milk is primarily due to iodine absorption through the skin rather than contamination of milk from teat surfaces (4, 21).

A recent study (10) indicated that use of a 1.0% iodophor postmilking teat dip as a premilking disinfectant dip with subsequent manual drying with paper towels was as effective in reducing bacterial counts of milk and on teat skin as other recommended udder preparations. A controlled iodine residue study was also conducted. Use of a 1% iodophor premilking teat dip with subsequent manual drying increased iodine content in milk by 60 μg/L. With the addition of 1% iodophor as a postmilking dip, (together with premilking teat dipping) iodine content increased to 150 μg/L. Drying of teats with dry paper towels reduced the increase dramatically. Use of iodophor premilking teat disinfectant with subsequent manual drying contributes to iodine content of milk. The increase depends on dairy producers milking practices and concentration of iodine in teat dip.

The objective was to determine effects of different iodine concentrations of postmilking disinfectant teat dips used as premilking teat dips with subsequent manual drying of teats on iodine residue in milk in commercial herds.

MATERIALS AND METHODS

Seven commercial herds were used so variations in milking practices would be represented. Eighty cows in each herd were assigned randomly by using a random number table to one of four treatments. Treatments are in Table 1. Treatments were applied by dairy producers at each milking. In treatments 2 and 4, dry paper towels (one towel per cow) were used to dry teats immediately after dipping with the premilking teat disinfectant. No water was used in cleaning teats in these treatments. In treatments 1 and 3, teats were cleaned with water only. Teats were dried immediately with individual dry paper towels (one towel per cow). Milking units were attached immediately after teats were dried in all treatments. During an adjustment period of 8 d, all cows were fed the same ration, no iodophor sanitizers were used, and teats were dipped after milking.

| TABLE 1. Median values of iodine content of milk by treatment. |
|-----------------|-----------------|-----------------|
| Treatment                  | Adjustment period | Treatment period | Difference |
| _______________________ | ___________________ | ___________________ | ____________ |
| 1) No premilking disinfectant dip, drying, .1% iodophor postmilking teat dip | 257             | 292             | 35<sup>a</sup> |
| 2) .1% Iodophor premilking disinfectant dip, drying, .1% iodophor postmilking teat dip | 247             | 294             | 47<sup>a</sup> |
| 3) No premilking disinfectant dip, drying, 1.0% iodophor postmilking teat dip | 260             | 336             | 76<sup>b</sup> |
| 4) 1.0% Iodophor premilking disinfectant dip, drying, 1.0% iodophor postmilking teat dip | 278             | 388             | 110<sup>c</sup> |

<sup>a,b,c</sup>Medians with different superscripts differ (P<.01).

<sup>1</sup>Quarter Mate™, West Agro-Chemical, Inc.

<sup>2</sup>Bovadine™, West-Agro Chemical, Inc.
with a noniodophor teat dip. After the adjustment period, an 8-d experiment was conducted with application of treatments. Milk was collected from each cow from weigh jars or milk meters at p.m. milkings. Iodide-specific ion electrode analysis was used to measure iodine concentration in milk (6).

Baseline milk iodine concentration was established for each cow by calculating the mean milk iodine from the last 3 d during the adjustment period. Milk iodine of each cow’s milk was measured on treatment d 4, 6, and 8, and the mean treatment period milk iodine concentration was calculated. The difference between treatment and baseline mean iodine was each cow’s response to treatment. Treatment responses were distributed abnormally, so median values were used to summarize treatment group responses.

Treatment responses were log-transformed and tested by analysis of variance. The model included terms for herd, iodine concentration of teat dip (.1%, 1.0), timing of dipping (premilking and postmilking versus postmilking only), and interactions between level and timing or herd. A secondary question was whether milk iodine concentration increased between d 4 and 8 of the treatment period. Each cow’s d 4 iodine was subtracted from d 8 concentration. A one-sided Wilcoxon signed rank test was done on differences (19).

RESULTS AND DISCUSSION

Data indicated significant differences for herd \((P<.01)\), iodine concentration of teat dip \((P<.001)\), and timing of dipping \((P<.001)\), and no significant differences for interactions between iodine concentration and timing \((P>.80)\) or herd \((P>.70)\). Effects of treatment on iodine residue of milk are in Table 1. No significant difference \((P>.10)\) existed between treatments 1 and 2, suggesting that .1% iodophor teat dip can be used as a premilking disinfectant dip with subsequent manual drying without significantly increasing iodine residue in milk. Treatment 3 (no premilking disinfectant dip, drying, 1.0% postmilking teat dip) significantly increased iodine residue beyond the combination of both .1% iodophor premilking and postmilking disinfectant teat dipping. The use of a 1% iodophor postmilking teat dip in this study resulted in an increase in milk iodine residue similar to results of previous studies (4, 10). The combination of 1% iodophor premilking and postmilking teat dipping (treatment 4) resulted in significantly higher \((P<.01)\) iodine residue in milk compared with treatment 3 with no 1% iodophor premilking teat disinfectant. Regardless of iodine concentration in the teat dip, the increase in iodine residue of milk was greater between adjustment period and treatment period with postmilking dipping only than for groups dipped both premilking and postmilking. This implies use of a postmilking iodophor teat dip might be more important in elevating milk iodine content than use of an iodophor premilking teat dip with subsequent manual drying. However, to determine actual changes in milk iodine content associated with premilking and postmilking teat dipping, an additional treatment of no premilking and postmilking teat dipping would be needed. A previous study (10) reported no significant increase in milk iodine content with the use of premilking teat dipping with subsequent manual drying and no postmilking teat dipping versus no premilking and postmilking iodophor teat dipping. However, when 1% iodophor postmilking teat dipping was added to premilking teat dipping with subsequent manual drying, milk iodine content in the milk increased significantly.

Conrad and Hemken (4) reported the primary mode of increased iodine in milk associated with postmilking teat dipping appeared to be absorption through teat skin rather than by contamination from the teat’s surface. This would suggest that less absorption of iodine through the teat’s skin would occur from premilking teat dipping with subsequent manual drying than from postmilking teat dipping only because of the shorter contact on the teat surface. However, the amount of iodine entering milk from teat surface contamination would depend on management practices associated with premilking teat dipping. There were significant herd effects, so herds had different baseline and posttreatment iodine concentrations in milk. However, because there was no herd by treatment interaction, treatment responses were consistent across herds. The 10th and 90th percentiles are in Table 2 to show the variation among cows. According to the signed rank test, there was no significant
TABLE 2. The 10th and 90th percentiles of milk iodine concentrations.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Adjustment period</th>
<th>Treatment period</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>10th %</td>
<td>90th %</td>
</tr>
<tr>
<td>1) No premilking disinfectant dip, drying, .1% iodophor postmilking teat</td>
<td>153 447</td>
<td>185 524</td>
</tr>
<tr>
<td>dip</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2) .1% Iodophor premilking disinfectant dip, drying, .1% iodophor postmilking teat dip</td>
<td>144 435</td>
<td>181 495</td>
</tr>
<tr>
<td>3) No premilking disinfectant dip, drying, 1.0% iodophor postmilking teat</td>
<td>144 478</td>
<td>197 518</td>
</tr>
<tr>
<td>dip</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4) 1.0% Iodophor premilking disinfectant dip, drying, 1.0% iodophor postmilking teat dip</td>
<td>157 458</td>
<td>220 623</td>
</tr>
</tbody>
</table>

increase in milk iodine concentration from d 4 to 8 (P>.50), thus indicating no accumulation of iodine in the udder during this time.

From this experiment, the following can be concluded: 1) concentration of iodine in iodophor teat dips affects iodine residue in milk; 2) .1% iodophor premilking teat dip added an insignificant amount of iodine to milk when used in conjection with .1% iodophor postmilking teat dip; 3) there is no additive time effect of iodine residue in milk when iodophor premilking teat dips are used; and 4) premilking disinfectant dipping practice needs to be monitored within each herd to minimize iodine residue in milk.

REFERENCES

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