ABSTRACT

Factors affecting progesterone concentration in milk of lactating dairy goats and use of this milk for pregnancy diagnosis were studied. Radioimmunoassay was used to assay progesterone in milk. Mean milk progesterone (ng/ml) ± standard errors of 6 pregnant does for first, composite, and last milk were 9.9 ± 2.0, 18.2 ± 3.5, and 21.7 ± 4.1. Correlation between milk fat and progesterone in composite milk was low (.11). Composite milk samples from 4 nonpregnant does were obtained daily throughout the estrous cycle. Milk progesterone (ng/ml) was 1 to 2 at estrus, rose to 5 to 12 within 2 to 5 days, reached a plateau at 15 to 25 in the middle of the estrous cycle, and then dropped to low concentrations again at 3 to 5 days before the next estrus. Milk progesterone also was used to diagnose pregnancy in 72 does. Forty-two does were diagnosed pregnant by high progesterone; 36 of these does later produced kids, and 5 other does aborted in various stages of pregnancy. Of 21 does diagnosed not pregnant with low progesterone, 19 does were not pregnant by either return to estrus or lack of parturition in the spring. All three incorrectly diagnosed does were problem breeders. Nine does with intermediate milk progesterone were classified questionable. Milk progesterone can be used to provide an early indication of the pregnancy status of does.

INTRODUCTION

Within the last few years, much research has been conducted on the use of milk progesterone for early pregnancy diagnosis in the lactating dairy cow (3, 5, 10, 12). Milk progesterone measurements for pregnancy diagnosis also have been extended to other species including the goat and the mare (2, 8, 9, 15). In the goat, palpation per rectum is not used for pregnancy diagnosis because of the relative size of the goat, and other methods of early pregnancy diagnosis have gained only limited use (4). Thus, there appears to be a need in the dairy goat industry for a highly reliable, simple test for pregnancy. Even return to estrus, which is the most used method of pregnancy diagnosis for dairy goats, is of questionable value toward the end of the breeding season as goats are seasonal breeders. A portion of goats are assumed to be pregnant because of lack of estrus until they do not produce a kid the next spring. They come into estrus primarily in the fall and then do not
return to estrus later in the season even if they are not pregnant. These experiments then were to determine the efficiency of milk progesterone for pregnancy diagnosis in lactating dairy goats.

MATERIALS AND METHODS

Animals and Method of Sampling

Does in this study were from three cooperating dairy herds. Samples (50 ml) were composite milk except as noted in Experiment 1 and were preserved with potassium dichromate (.0324 g tablet, NASCO, Fort Atkinson, WI). Samples were hand carried or shipped in cylindrical, cardboard mailing cartons via United Parcel Service to the laboratory.

Radioimmunoassay of Progesterone

Progesterone was assayed after ether extraction of milk as outlined by Pennington et al. (13). The antiserum S83 #5 was obtained from G. E. Abraham, Torrence, CA. All analyses were within 2 wk of sample collection.

Experiment 1: Method of Sampling

Samples of first, composite, and last milk were collected from 6 pregnant does at the p.m. milking. Fat percentages in milk were measured on all samples by Babcock method (1). Statistical analysis was by a two-way factorial design (does × method of sampling) with comparison of means by Duncan's new multiple range test (17).

Experiment 2: Day of Estrous Cycle

Milk samples were collected at the p.m. milking from 4 does on the day of estrus and from these same 4 does each day until the next estrus. Statistical analysis was by a randomized complete block design (17).

Experiment 3: Pregnancy Diagnosis

Samples of composite milk were collected from 72 lactating does at 21 days postbreeding. Does were classified as pregnant, questionable, and not pregnant with greater than 10 ng, 7 to 10 ng, and less than 7 ng progesterone/ml in milk, respectively. These diagnoses were compared with return to estrus, detected abortions, and kidding results.

TABLE 1. Effect of method of sampling on progesterone concentration in milk.

<table>
<thead>
<tr>
<th>Sampling method</th>
<th>Progesterone (ng/ml)</th>
<th>Milk fat (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>X</td>
<td>SE</td>
</tr>
<tr>
<td>First milk</td>
<td>9.9A</td>
<td>2.0</td>
</tr>
<tr>
<td>Composite milk</td>
<td>18.2B</td>
<td>3.5</td>
</tr>
<tr>
<td>Last milk</td>
<td>21.7B</td>
<td>4.1</td>
</tr>
</tbody>
</table>

A,B,C Means in same column with different superscripts differ (P<.01).

RESULTS AND DISCUSSION

Experiment 1: Method of Sampling

Method of sampling had a significant effect (P<.01) on progesterone concentration in milk (Table 1). Correlation between fat percentage and progesterone concentration in the three milk fractions was .82 (P<.05). However, correlation between fat percentage and progesterone concentration in composite milk was .11 (P>.10). Effect of does on progesterone concentrations also was significant (P<.05). Interactions of animal and method of sampling did not affect (P>.10) progesterone concentration in milk.

Several studies have indicated that progesterone in bovine milk is affected by milk fat percentage (6, 7, 11). Similar to results reported here in goats, the correlation between milk progesterone concentration and fat percentage in cattle is much lower in composite milk than in all three fractions of milk (11, 14).

Thibier et al. (18) recently reported that progesterone in first milk from does in the luteal phase of the estrous cycle was approximately 10 ng/ml, which would agree closely with our data. Holdsworth and Davies (8) reported 52.9 ng/ml in whole milk of pregnant does. Throughout these studies, concentrations of progesterone in milk tended to be slightly lower than those for progesterone in cows' milk by a similar assay system (14).

Experiment 2: Day of Estrous Cycle

Effects of does and of days in the estrous cycle on progesterone concentration in milk were significant (P<.01). Patterns of milk
progesterone during the estrus cycle in Figure 1 were similar to patterns of progesterone in blood and in milk (18, 19).

Most milk progesterones were in the range of 15 to 22 ng/ml from day 6 to day 16 of the estrous cycle except for one goat that erratically had up to 38 ng/ml. Variation in progesterone concentration in dairy goat milk was comparable to that for lactating dairy cows (14), and data followed a similar pattern to results for both bovine milk and blood progesterone (7, 16).

Experiment 3: Pregnancy Diagnosis

Progesterone concentrations in milk ranged from .5 to 34 ng/ml. For does classified as pregnant, not pregnant, and questionable by milk progesterone, milk concentrations of progesterone averaged 17.9 ± .9, 3.0 ± .4, and 9.4 ± .4 ng/ml, respectively. Results of pregnant diagnosis are in Table 2. For animals classified as pregnant by milk progesterone, 97.6% (41 of 44) later either produced a live kid or were detected aborting. Five of these animals did abort in various stages of pregnancy. Of the 21 does diagnosed not pregnant with low progesterone, 19 does (90.4%) were nonpregnant by either return to estrus or lack of parturition in the spring. Nine does with intermediate milk progesterone were classified questionable. Seven of the nine animals classified questionable were pregnant.

Of the animals diagnosed incorrectly by milk progesterone, all were problem breeders for their owners. The two animals diagnosed incorrectly as not pregnant with low progesterone had in previous gestations been unable to carry a kid and had aborted. The animal that was diagnosed incorrectly as pregnant but did not produce a kid also had been a problem breeder and had aborted.

These results agree closely with results by Holsworth and Davies (8) and Pennington et al. (15). The field trial of 98 goats in the United Kingdom resulted in an 85.9% accuracy on positive diagnosis based on kidding data and 100% accuracy for 6 goats having negative results (8). Pennington et al. (15) found that 21 of 22 does diagnosed pregnant by milk progesterone were pregnant (18 kidding plus three abortions), whereas all three does diagnosed not pregnant did not kid.

The accuracy of pregnancy diagnosis by milk progesterone in dairy goats appears to be higher than the accuracy of diagnosis by milk progesterone in dairy cattle in our studies (12, 13). We speculate that increased accuracy of pregnant diagnosis by progesterone in goats as compared to cattle may be from two related factors, higher fertility and decreased effect of embryonic death. Increased accuracy of pregnancy diagnosis by milk progesterone in cattle occurs as conception rates increase. The accuracy of cows diagnosed pregnant by milk progesterone is more affected by fertility than those diagnosed not pregnant (3, 12). In cases of multiple embryos, which are common in goats, if one embryo dies, another embryo will sustain pregnancy. Thus, less incidence of nonpregnancy results from embryonic death in the goat than in the cow. Embryonic death has been a major cause of discrepancies in diagnosis of cows pregnant by milk progesterone (3, 4, 7, 12).

TABLE 2. Pregnancy diagnosis by milk progesterone on day 21.

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>Accuracy of diagnosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not pregnant</td>
<td>19/21 = 90.4%</td>
</tr>
<tr>
<td>Pregnant</td>
<td>41/42 = 97.6%</td>
</tr>
<tr>
<td>Total(^1)</td>
<td>60/63 = 95.2%</td>
</tr>
</tbody>
</table>

\(^1\) Diagnosis by milk progesterone.

\(^2\) Does diagnosed pregnant and not pregnant only; 9 additional does were classified questionable.
ACKNOWLEDGMENTS

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REFERENCES