Abstract

Cows were paired in two groups by lactation number and milk production. Twenty cows in group 1 were injected intramuscularly twice daily (0700 and 1900) for 10 days with 50 μg thyrotropin releasing hormone in .5 ml sterile .85% NaCl and then injected with .5 ml .85% NaCl for days 11 to 20. The sequence of treatment was reversed for the 19 cows in group 2. Average milk yield was .66 kg/cow per day greater during the last 5 days of hormone administration relative to the comparable period of NaCl treatment. Average milk yields were increased .72 and .22 kg for groups 1 and 2 within 1 day after hormone injections were begun. Average milk production was slightly increased or maintained throughout hormone treatment relative to the period preceding, then decreased approximately 1.8 kg 1 to 3 days after withdrawal. Percent protein and fat were unchanged by treatment. We conclude that thyrotropin releasing hormone can increase milk production in dairy cows but does not affect milk composition. The modest increase in milk production caused by the hormone is encouraging to continued study of this tripeptide as a stimulus to milk production.

Introduction

Synthetic thyrotropin releasing hormone (TRH), L-(Pyro)-Glu-His-Pro-NH₂ (2, 5), increases serum thyroxine, prolactin, and growth hormone concentration of lactating dairy cows (3). These three hormones all have been implicated importantly in the physiology of lactation.

The stimulatory effect of thyroid active materials on yield and composition of milk from dairy cows has been researched and reviewed extensively (1, 8, 12). Although thyroprotein caused increased milk yield, it also caused suppression of endogenous thyroid secretion to the extent that upon withdrawal of thyroprotein, serum thyroxine concentration decreased to hypothyroid range (10). This precipitous decline in serum thyroxine may account for the severe reduction in milk yield after thyroprotein withdrawal. In contrast, stimulation of the hypothalamic-hypophysial-thyroid axis with TRH should increase serum thyroxine only to the upper extreme of the euthyroid range after which thyroxine feedback on pituitary thyrotrophs would desensitize them to additional TRH stimulation (9). Therefore, the thyroid imbalance, characteristic of thyroprotein feeding, would not be predicted with TRH administration.

Bovine growth hormone has increased milk production in dairy cows (4, 6, 13). Although growth hormone preparations were of varying degrees of purity, there is little doubt that the active ingredient was growth hormone. In contrast, prolactin has not been demonstrated to be galactopoietic in dairy cows or goats. Thus, Sulmon and Twersky (11) reported that highly purified prolactin did not influence established lactation in cattle. But Koprowski and Tucker (7) reported a positive correlation between the magnitude of prolactin release at milking and milk production. Data of this type suggest that the prolactin surge at milking may influence importantly subsequent milk yield.

The foregoing considerations interested us to determine whether administration of TRH to dairy cows would influence milk yield and composition.

Materials and Methods

Forty lactating cows of the Michigan State University herd were allowed 4 hr pasture daily and fed haylage ad libitum supplemented with .45 kg grain/1.14 kg milk. Cows were paired in two groups by lactation number and milk production during a 21-day acclimatization period. Twenty cows in group 1 were injected intramuscularly twice daily for 10 days.
with 50 μg TRH in 500 μl sterile .85% NaCl and then injected with .5 ml sterile .85% NaCl for days 11 to 20. The TRH-NaCl treatment sequence was reversed for the second group of 20 cows. Injections were administered at 0700 and 1900. Daily milk weights were recorded and samples collected for fat (Babcock) and protein (Kjeldahl) analysis on days 1, 3, 5, 7, 9, and 10 of each 10-day period. One cow in group 2 was dropped from the trial and is not included in the analysis. Variance was analyzed to evaluate significance of treatment on milk weights and protein and fat in milk.

Results

Average milk production before, during, and after treatment is in Table 1. Average milk yield was .66 kg/cow per day greater (P<.02) during the last 5 days of TRH administration as compared to that of NaCl treatment. Average daily milk yields were increased .72 and .22 kg the day after TRH injections were begun compared to values on the day preceding initial TRH injection for groups 1 and 2. The significant point is that milk production was increased slightly or maintained throughout TRH treatment relative to the period preceding, then decreased approximately 1.81 kg 1 to 3 days after TRH withdrawal. Average milk production of cows in group 1 during the last 3 days of TRH administration was 21.4 kg/day and decreased to 19.3 kg/day 2 to 3 days after saline treatment was begun. Similarly, milk production of cows in group 2 averaged 20.2 kg/day during the last 2 days of treatment with TRH, then decreased to an average of 18.1 kg/day the second and third day after withdrawal of exogeneous TRH. Milk production remained elevated for 1 day after TRH administration ceased. Percent protein and fat of milk collected during TRH treatment averaged 3.48 and 3.18 compared with 3.47 and 3.20 for samples during saline treatment; differences between means were not significant (P>.05; Table 2).

**Table 1. Average daily milk production of cows treated with thyrotropin releasing hormone (TRH).**

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>-5-0</th>
<th>3-5</th>
<th>6-10</th>
<th>13-15</th>
<th>16-20</th>
<th>22-24</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>(kg/day)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>20</td>
<td>20.8</td>
<td>21.6</td>
<td>21.0</td>
<td>19.7</td>
<td>19.7</td>
<td>18.3</td>
</tr>
<tr>
<td>2</td>
<td>19</td>
<td>21.5</td>
<td>21.5</td>
<td>19.9</td>
<td>20.5</td>
<td>20.0</td>
<td>18.1</td>
</tr>
</tbody>
</table>

* L (Pyro)-Glu-His-Pro-NH₂.

b 50 μg TRH injected intramuscularly twice daily at 0700 and 1900.

c 500 μl sterile saline injected twice daily at 0700 and 1900.

d X Days 3 to 10: TRH = 20.7; Saline = 20.1

Table 2. Average protein and fat content of milk from cows treated with thyrotropin releasing hormone (TRH).

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>-5 to 0</th>
<th>1 &amp; 3</th>
<th>5, 7, 10</th>
<th>11 &amp; 13</th>
<th>15, 17, 20</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>(%) Protein</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>20</td>
<td>3.16</td>
<td>3.47</td>
<td>3.46</td>
<td>3.51</td>
<td>3.38</td>
</tr>
<tr>
<td>2</td>
<td>19</td>
<td>3.22</td>
<td>3.51</td>
<td>3.47</td>
<td>3.57</td>
<td>3.43</td>
</tr>
</tbody>
</table>

TRH = 3.48; Control = 3.47

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>-5 to 0</th>
<th>1 &amp; 3</th>
<th>5, 7, 10</th>
<th>11 &amp; 13</th>
<th>15, 17, 20</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>(%) Fat</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>20</td>
<td>3.5</td>
<td>3.1</td>
<td>3.3</td>
<td>3.5</td>
<td>3.1</td>
</tr>
<tr>
<td>2</td>
<td>19</td>
<td>3.5</td>
<td>3.0</td>
<td>3.2</td>
<td>3.2</td>
<td>3.1</td>
</tr>
</tbody>
</table>

TRH = 3.18; Control = 3.20

* L (Pyro)-Glu-His-Pro-NH₂.

b 50 μg TRH injected intramuscularly twice daily at 0700 and 1900.

c 500 μl sterile saline injected twice daily at 0700 and 1900.

* Supplied by Dr. R. Rippel, Abbott Laboratories, North Chicago, Illinois.
Discussion

Our results demonstrate that TRH increases milk production in cows. The increase in milk relative to controls results primarily from TRH reducing the decline in milk production characteristic of advancing lactation. This experiment does not provide information as to how TRH exerts its effect although our previous work with TRH (3) suggests that it may be via increased availability of prolactin, growth hormone, or thyroxine acting alone or in combination.

Although results of this experiment are preliminary and to be interpreted with caution, the modest increase in milk yield with TRH is encouraging to continued experimentation, especially in view of the paucity of information concerning the physiology of TRH. Information concerning: (i) effective dose, (ii) method of administration, (iii) time of administration, (iv) effective stage of lactation, and (v) effective feed intake should provide the means to expand the margin of effectiveness of this tripeptide.

References