STUDY OF SERUM GROWTH HORMONE, 3,5,3’-TRIIODOTHYRONINE, THYROXINE, TOTAL PROTEIN AND FREE FATTY ACIDS LEVELS DURING PARTURITION AND EARLY LACTATION IN EWES

AYŞEN ALTINER

Department of Biochemistry, Faculty of Veterinary Medicine, Istanbul University, 34320 Avcilar, Istanbul, Turkey
e-mail: afira@operamail.com

Received for publication July 21, 2005.

Abstract

Fifteen Chios pregnant ewes were used in the study. The ewes were fed hay and concentrated feed ad libitum. Water was provided ad libitum. Blood samples were collected from the jugular vein at parturition and day 15 after parturition. Concentrations of growth hormone (GH) were determined by an enzyme immunoassay. 3,5,3’-triiodothyronine (T3) and thyroxine (T4) contents were measured by radioimmunoassay with commercial kits. Concentrations of free fatty acids (FFA) and total protein were determined spectrophotometrically with commercial kits. GH, FFA and T3 levels tended to be lower on day 15 after parturition, but no significant differences were found between two blood sampling days. T4 and total protein levels tended to be higher on day 15 after parturition, but similarly, there were not significant differences between parturition and day 15 after parturition. In conclusion, serum GH, FFA, T3, T4 and total protein levels did not significantly change between parturition and day 15 after parturition. The obtained results may be accepted as reference values for ewes.

Key words: ewe, parturition, lactation, somatotropin, thyroid hormones, protein, free fatty acids.

Growth hormone (GH) is essential for postnatal somatic growth, maintenance of lean tissue at maturity in domestic animals and milk production in ruminants. In animal industries, increased concentrations of GH are of economic importance because they are associated with faster growth, less fat stores and, in the dairy industry, more efficient milk production in ruminants (14). GH and its receptors are produced in the hypophysis, gonads, uterus, placenta, mammary gland, leukocytes, and other tissues. GH, besides its known anabolic, growth-promoting, immuno-stimulating, and other non-reproductive functions, is also important in the control of reproduction. Measurement of GH production, secretion, and metabolism can be used for the detection and prediction of not only growth and metabolism, but also of reproduction and reproductive disorders (18).

Free fatty acids (FFA) are typically released into the blood stream when glucose levels fall. The hormone sensitive lipase hydrolyses triglycerides to FFA and glycerol. FFA are removed from plasma by the liver and, if sufficient oxaloacetate is available, converted into acetyl CoA to be oxidized in the citric acid cycle. Typically when oxaloacetate levels are low due to increased utilization in the gluconeogenesis, the FFA derived acetyl CoA is recondensed to form ketones (19).

Thyroid hormones are key players in tissue differentiation, growth, and functioning with major effects on metabolism and oxygen consumption. The thyroxine (T4) form is important for transport and negative feed-back regulation, 3,5,3’-triiodothyronine (T3) is the active hormone in target cells. T3 stimulates mRNA transcription, resulting in protein synthesis and anabolic effects. Also, it stimulates Na+, K+-ATPase at the cell membrane, thus increasing O2 consumption. Other effects are increased temperature, behavioural activity, weight loss, increased glucose turn-over, cholesterol catabolism, stimulation of growth and maturation. Also, thyroid hormones play a role in fertility and have stimulatory effects on bovine granulosa and theca cells (19).

The aim of this study was to determine the changes of serum GH, T3, T4, total protein, and FFA levels during parturition and early lactation in ewes.

Material and Methods

Fifteen Chios pregnant ewes were used in the study. All individuals appeared clinically healthy. They were handled with care to minimize any possible effects of stress. The ewes were fed hay and concentrated feed ad libitum (Table 1). Water was provided ad libitum. Blood samples were collected from the jugular vein at
parturition and 15 d after parturition. The samples were allowed to coagulate spontaneously at room temperature, and sera were obtained by centrifugation at 5000 g for 15 min. Serum samples were stored in −20°C until assays. Concentrations of GH were determined by an enzyme immunoassay (17). T₃ and T₄ concentrations were measured by radioimmunoassay with commercial kits (Liege, Biocode, Belgium). Concentrations of FFA and total protein were determined spectrophotometrically with commercial kits (Chema Diagnostica, Jesi, Italy).

<table>
<thead>
<tr>
<th>Nutrients</th>
<th>Hay</th>
<th>Concentrated supplement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crude protein</td>
<td>5.42</td>
<td>16.0</td>
</tr>
<tr>
<td>Crude fiber</td>
<td>43.55</td>
<td>10.0</td>
</tr>
<tr>
<td>Crude ash</td>
<td>5.55</td>
<td>10.0</td>
</tr>
<tr>
<td>Crude oil</td>
<td>0.85</td>
<td>3.3</td>
</tr>
<tr>
<td>Dry matter</td>
<td>88.52</td>
<td>88.00</td>
</tr>
<tr>
<td>Calcium</td>
<td>0.11</td>
<td>0.80</td>
</tr>
<tr>
<td>Phosphorus</td>
<td>0.10</td>
<td>0.50</td>
</tr>
<tr>
<td>Sodium</td>
<td>0.1</td>
<td>0.1</td>
</tr>
</tbody>
</table>

Mean serum GH, T₃, T₄, FFA and total protein concentrations were compared between parturition day and day 15 after parturition using a two-tailed Student’s t test. Results are presented as mean ± SE.

**Results**

Serum GH, T₃, T₄, FFA, and total protein levels of ewes are given in Table 2. GH, FFA and T₃ levels tended to be lower on day 15 after parturition, but no significant differences were found between two blood sampling days. T₄ and total protein levels tended to be higher on day 15 after parturition, but similarly, there were no significant differences between parturition and day 15 after parturition.

**Discussion**

GH acts by partitioning nutrients toward milk synthesis. A primary action appears to be increased release and turnover rate of FFA from adipose tissue in ruminants near zero or in negative energy balance. In addition to supplying precursors for increased milk fat output, a portion of the FFA may be utilized by peripheral tissues, sparing glucose for uptake by the mammary gland. FFA should be available for oxidation by the liver to support synthetic processes such as gluconeogenesis (16).

Plasma GH concentrations increase throughout pregnancy and are high in early lactation. In early lactation in ruminants the hormone appears to exert diabetogenic effects resulting in increased glucose production whereas in later lactation lipolytic effects predominate (10). Law et al. (9) reported that endogenous GH secretion is elevated during the periparturient period. Lucy et al. (11) stated that cows consuming different diets had similar concentrations of GH in plasma. De Boer and Kemelly (2) determined that dietary crude protein content had limited influence on GH metabolism in cows at approximately 155 d postpartum.

Pocius and Herbein (16) found 5.6 ng/ml GH concentration in lactating Holstein cows between 119 and 123 d postpartum. De La Sota et al. (4) demonstrated that plasma GH concentrations were 3.1 ng/ml in lactating cows and 2.8 ng/ml in non-lactating cows. Law et al. (9) found that plasma GH contents in cows were 6.3 ng/ml 1 d before calving, 11.9 ng/ml at calving and 12.4 ng/ml 1 d after calving. The same authors reported that in untreated cows, plasma GH concentrations fluctuated periodically, and the absolute mean concentration varied between 3 and 15 ng/ml. In the present study, serum GH concentration did not significantly change between parturition and day 15 after parturition. The level tended to decrease 15 d after parturition and the values were within limits reported by Law et al. (9).

FFA can be oxidized by the skeletal muscles and pregnant uterus (8). During the last third of pregnancy foetal energy demands dramatically increase and mobilization of lipid reserves. This rises the levels of plasma FFA (10). In late pregnancy, ruminants often exhibit increased blood concentrations of FFA which reflect inadequate supplies of absorbed energy or glucose. FFA are mobilized from body fat stores to meet a shortage of dietary energy (8).

Plasma FFA remain elevated in early lactation largely because feed intake fails to keep pace with nutrient requirements for milk synthesis, resulting in adipose tissue mobilization. Because plasma FFA equilibrates with FFA liberated during the mammary uptake of blood triacylglycerol, there is a simultaneous uptake and release of FFA. In properly fed lactating ruminants, when plasma FFA levels are usually low, net uptakes of FFA by the mammary gland are negligible. FFA may contribute significantly to mammary metabolism (10).
FFA seem to be higher in high genetic merit cows than in low genetic merit ones and higher in Holstein-Fresian dairy cows than in dual purpose breeds (19). Harrison et al. (7) reported similar differences, but only in the first 2 weeks of lactation. There are no studies that report on differences in the opposite direction, but several authors found no effect of genetic merit for milk yield on concentrations of FFA (6, 12, 15).

De Boer and Kennelly (3) reported that increasing dietary crude protein significantly increased FFA concentrations and reflects the mobilization of FFA for milk synthesis. De La Sota (4) stated that non-lactating cows had greater concentrations of FFA in plasma than lactating cows. In the present study, serum FFA levels did not significantly change between parturition and the 15th d after parturition. This may show that important mobilization of body fat stores did not occur during early lactation in comparison with parturition (8).

El-Barody et al. (5) reported that breed differences were observed for T4 and total protein levels, and T4 hormone concentration was found to be negatively associated with the age. The authors suggested that young animals have a higher thyroid hormone output than the adult ones. Casamassima et al. (1) noted that neither free-T3 nor free-T4 blood levels were changed by housing system.

Mandiki et al. (13) reported that the high level of rapeseed meal did not affect the thyroid function either during gestation or during lactation except a slight decrease in T4 observed during lactation in ewes. Also, the authors demonstrated that as compared to the end of gestation, the plasma T3 concentrations increased during lactation and this increase was not observed for T4. On the contrary, in the present study, serum T3 concentration tended to decrease and serum T4 concentration tended to increase on day 15 after parturition according to parturition.

In conclusion, serum GH, FFA, T3, T4 and total protein levels did not significantly change between parturition and the 15th d after parturition. The obtained results may be accepted as reference values for ewes.

References