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Full Length Research Paper

Effect of serotonin infusions on the mean plasma concentrations of growth hormone, thyroid hormones and the amount and constituents of milk in the Sanan goat

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The goal of this study was to determine whether serotonin increase the mean plasma concentrations of thyroxine (T4), triiodothyronine (T3), growth hormone (GH), milk amount and constituents in the Sanan goats. Nine Sanan goats were randomly divided into 3 groups. Each group received daily infusion of 1, 4 or 8 ng serotonin agonist (hydroxytryptophan) (5HT) for 7 days. Blood and milk samples were collected daily on day 1 before infusions until 3 days after the last infusion. Samples were assayed for plasma T3, T4 and GH concentrations by double-antibody RIA. Milk samples were assayed for protein, fat and lactose constituents. The daily amounts of milk were determined throughout the experiment. Infusions of 1 ng 5HT did not change the plasma concentrations of the T3, T4 and GH throughout the experiment period. Infusions of 4 and 8 ng 5HT significantly ($p<0.01$) increased the plasma concentration of the T3, T4 and GH among animals. Infusions of 1and 4 ng 5HT did not change the amount and the protein, fat and lactose constituents of milk among all animals in the different groups. 8 ng 5HT significantly ($p<0.01$) increased milk amount from 0.6 to 1.2 liter on the 10th day of experiment. Infusions of 8 ng 5HT did not change the protein, fat and lactose constituents of milk. The result of these experiments indicated that serotonin may increase the mean plasma concentration of GH, T3, T4 in the Sanan goats.

Key word: Serotonin T3, T4, GH, Sanan goats.

INTRODUCTION

Metabolic hormones induce the amount and constituents of milk. Many studies have demonstrated that long term administration of metabolic hormones such as growth hormone (GH) and thyroxine (T4), either by injection or via feed as iodinated protein increases amount and constituents of milk by 10-40% (Binelli et al., 1995; Chalupa et al., 1987; Davis et al., 1988; Gallo etal., 1991; 1992; Khal et al., 1995; Khazali et al., 2000; Thomas et al., 1991).

Hypothalamic growth hormone releasing hormone (GHRH) and thyrotroph releasing hormone (TRH) induce pituitaric GH and TSH followed by T3 and T4 secretions. GHRH and TRH secretions are under different neurotransmitters. It has been shown that neurons secreting serotonin may be co-locolized with neurons secreting GHRH and TRH (Bujatti et al., 1976; Savard et al., 1986; Savard et al., 1983). This indicates that serotonin as a neurotransmitter may control GHRH and TRH secretion to increase GH, T3 and T4 secretions.

The following experiment were designed to determine whether serotonin increase the plasma concentration of T3, T4 and GH and consequently the milk amount and constituents in the Sanan goats.

MATERIALS AND METHODS

Animals

Nine Sanan goats (weighing between 40 to 50 kg) were housed in controlled chambers at a constant 25°C and 70% humidity and fed *ad libitum*. The goats were randomly divided into 3 groups. Each group

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received daily infusions of 1, 4 or 8 ng 5HT into third ventricle for 7 days.

Surgery

Surgical procedures were done under general anesthesia induced by sodium pentobarbital and maintained by halothane in a closed circuit system. Animals were cannulated into their third ventricle by stereotaxic technique two weeks before day 1 of experiment. Catheters were also made for the jugular vein with polysiloxane tubing.

Blood and milk collection

Blood samples were collected from jugular vein and daily on day 1 before injections until 3 days after the last infusion. Blood samples were kept at 4°C until centrifugation. A saturated sodium citrate solution (40 µl sodium citrate solution/ml blood) was added to the samples before centrifugation to prevent clotting of plasma during storage. Plasma was stored at -20°C until assayed for T3, T4 and GH. Milk samples were daily collected from day 1 day till day 11 of experiment. Milk samples were kept at 4°C until assay for protein, fat and lactose. The daily amounts of milk were determined throughout the experiment.

Hormone assays

Plasma T3, T4 and GH were measured by a homologous double-antibody radioimmunoassay (RIA). For GH assay, bovine GH (USDA-oGH-I-1) and antisera against GH were provided by Dr. A. F. Parlow (Director of Pituitary Hormones and Antisera Center, Harbor-UCLA Medical Center, 1000 West Carson Street, Torrance, CA). Ovine GH (USDA-oGH-I-1) was used for iodination. A seven-point standard curve ranging from 0.04 to 10 ng GH were used. An average assay binding of 40% was achieved using an initial 1:20,000 dilution of GH antiserum for GH assays. For T3 assay, T2 were purchased from Sigma Chemical Company and T3 antisera were purchased from Chemicon Co. (Temmecula, Ca). T2 were used for iodination. A six-point standard curve ranging from 0.32 to 5.2 ng T3/ml was used. An average assay binding of 70% was achieved using an initial 1:5000 dilution of T3 antiserum for T3 assays. For T4 assay, T3 were purchased from Sigma Chemical Company and T4 antisera were purchased from Chemicon Co.(Temmecula, Ca). T3 were used for iodination. A six-point standard curve ranging from 2.2 to 25 ng T4/ml was used. An average assay binding of 60%, was achieved using an initial 1:5000 dilution of T4 antiserum for T4 assays.

Chemical and statistical analyses

Concentrations of fat, protein and lactose in milk were determined using a semiautomatic infrared analyzer (Milkoscan 104; A/s N. Foss Electric, Hillerod, Denmark). Statistical analyses were conducted using General Linear Model procedures SAS, 1985 (12). Data were analyzed using an analysis of variance for a split plot in time design. Mean comparisons were evaluated by least significant difference with single degree of freedom. Data were analyzed by SAS (1985).

RESULTS AND DISCUSSION

Infusions of 1 ng 5HT did not change the plasma concentration of the T3, T4 and GH throughout the experiment period (Figures 1 to 3). Infusions of 4 and 8 ng 5HT significantly ($p<0.01$) increased the plasma concentration of the T3, T4 and GH among animals (Figures 1 to 3). Infusions of 1 and 4 ng 5HT did not change the amount and the protein, fat and lactose constituents of milk among all animals in the different groups. 8 ng 5HT significantly ($p<0.01$) increased milk amount from 0.6 to 1.2 liter on the 10th day of experiment. Infusions of 8 ng 5HT did not change the protein, fat and lactose constituents of milk (Figure 4).

One of the interesting finding of these experiment was the increase of plasma concentration of the T3, T4 and GH

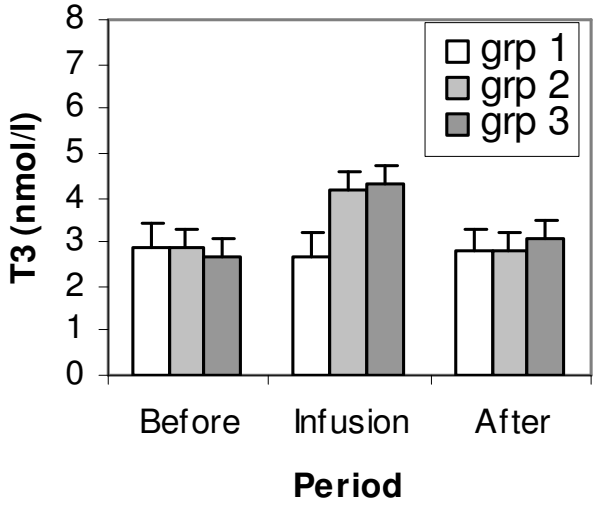

Figure 1. Mean plasma concentrations of T3 among animals of three groups before, during and after infusions of serotonin agonist, hydroxytryptophan (5HT).

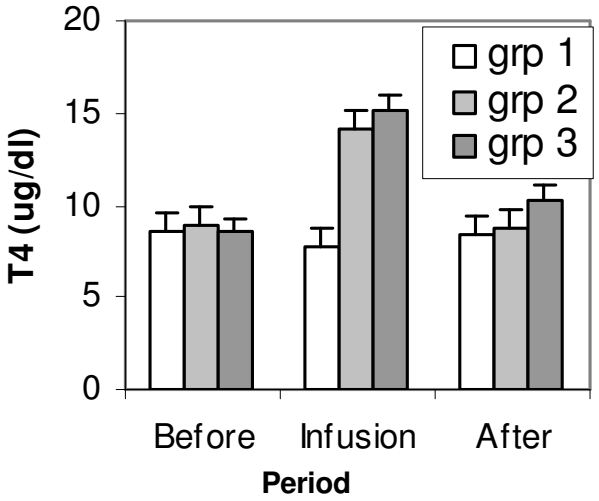

Figure 2. Mean plasma concentrations of T4 among animals of three groups before, during and after infusions of serotonin agonist, hydroxytryptophan (5HT).

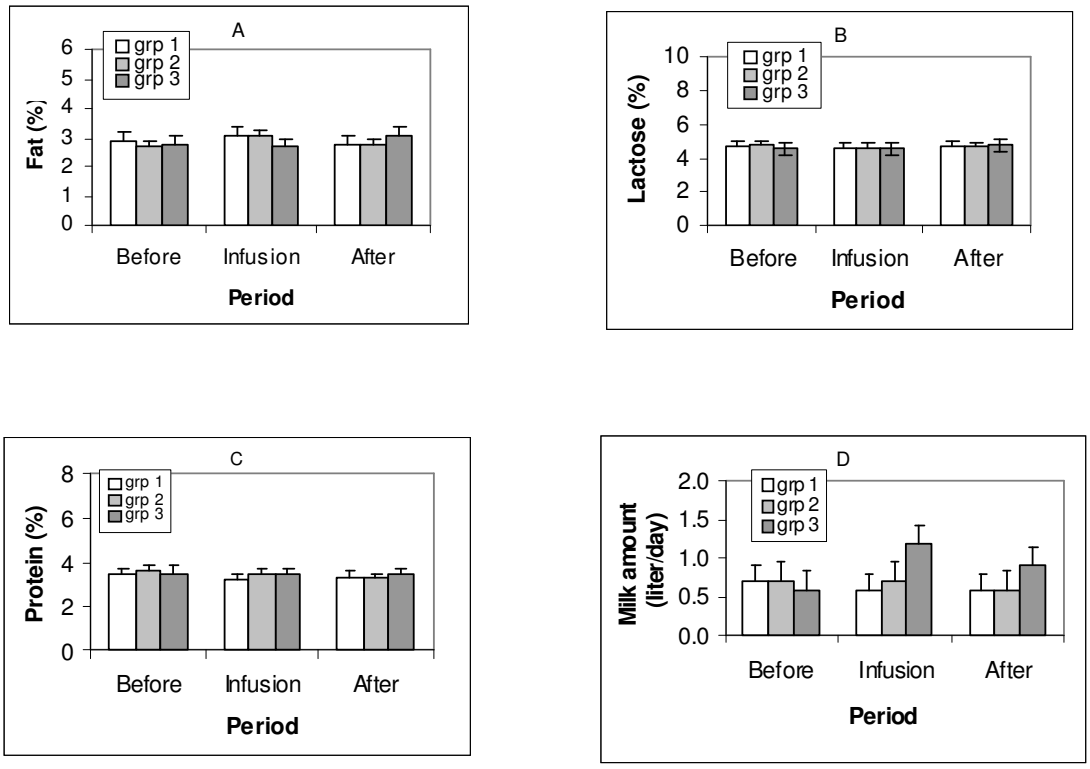

Figure 4. Mean milk fat percentage (A), lactose percentage (B), protein percentage (C) and milk amount (D) of animals of different groups before, during and after infusions of serotonin agonist, hydroxytryptophan (5HT).

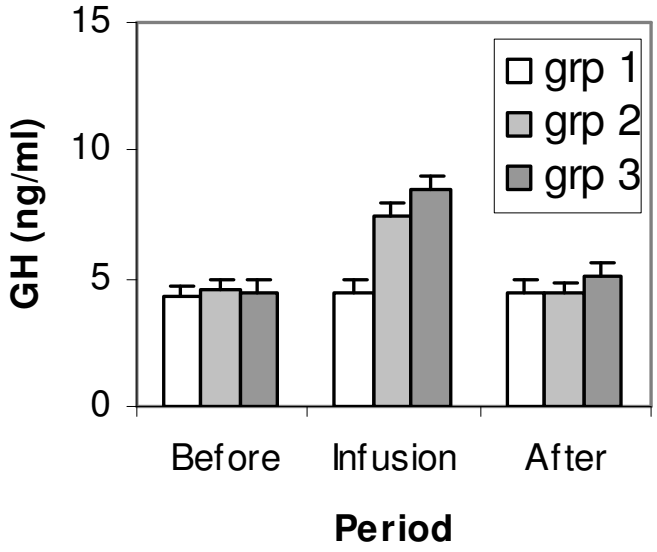

Figure 3. Mean plasma concentrations of GH among animals of three groups before, during and after infusions of serotonin agonist, hydroxytryptophan (5HT).

in those animals that received 4 and 8 ng 5HT. This is the first report of the effect of serotonin on the plasma concentration of the T3, T4 and GH in goat. This effect may be due to the co-localizations of serotonin neurons with neurons secreting GHRH and TRH. That is an indication of serotonin stimulation on T3, T4 and GH secretions Bujatti et al., 1976; Savard et al., 1986, Savard et al., 1983). Milk amount was increased among those animals receiving 8 ng serotonin. This result is similar with the previous finding of Khazali et al. (2000) who reported that GH and T4 treatment increase milk production. Infusions of 1 and 4 ng serotonin did not change the amount and the protein, fat and lactose constituents of milk among all animals in the different groups. This may be due to the need for more increase of GH secretions to obtain increase in the amount of milk. Therefore, serotonin may induce the T3, T4 and GH secretions in Sanan goat.

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