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Body Condition Score Positively Influence Plasma Leptin Concentrations in Criollo Goats

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Abstract: This study was evaluates the effect of body condition score (BCS) on leptin concentrations of Criollo goats under increased photoperiod in central Mexico (22°N). Mature Criollo goats (n = 24) were assigned to one of 4 experimental groups according to their BCS: Excellent (n = 6), Good (n = 6), Regular (n = 6) and Poor (n = 6). Blood samples were collected in 5 random dates during the experimental period (Feb-Jun) and leptin levels were analyzed by RIA. BCS affected ($p<0.0$) serum leptin concentration in a direct and proportional way; the better the BCS the greater serum leptin concentration. Results should help to understand adaptation mechanisms exerted by goats facing a marginal nutritional support. The last could be of economic significance especially in criollo goats managed under semi-arid conditions, in which scenarios of restricted nutrition prevail.

Key words: Criollo goats, increased photoperiod, body condition score, leptin

INTRODUCTION

In mammals, leptin is considered a metabolic signal that regulates the effects of nutritional status on reproductive function. However, it is not clear at which nutritional level the plasmatic concentration of this hormone rises. Nontheless, leptin secretion has been positively and highly correlated with body fat percentage and adipocite size (Block *et al*., 2003). Leptin production is modulated by insulin, glucocorticoids and sexual steroids and acts on the central nervous system inhibiting hypothalamic neuropeptide production, mainly neuropeptide Y (NPY), which is the most well known potent stimulating factor of appetite (Stephens *et al*., 1995). Leptin decreases food intake while increases the activity of the sympathetic nervous system, promoting increases in the basal metabolism as well as in the expenditure of energy. By this way, leptin signals to the neuroendocrine pathways the energy status of the animal. Integration of these outlying signals in the hypothalamic network, activates some metabolic pathways that control the level of energy expenditure (Halaas *et al*., 1995; Chehab, 1997).

In ruminants, leptin is secreted in a pulsating fashion, while in human and rats it depicts a circadian rhythm of secretion with high concentrations at midnight up to early morning and low concentrations between midday and afternoon. However, leptin blood concentrations can vary due to intrinsic factors, one of these is due to the quantity and specific secretion profile of transport proteins. Furthermore, secretion also can be affected by changes in diet, in adipose tissue level as well as in the nutrient flow due to metabolic priorities associated to gestation, nursing or infections (Campfield *et al*., 1995; Halaas *et al*., 1995; Amstalden *et al*., 2000; Chehab, 2000; Ingvarsten and Boisclar, 2001). The objective of this study was to evaluate the effect of the body condition score upon serum leptin concentrations in Criollo goats.

MATERIALS AND METHODS

The experiment was conducted from February to July 2006 at the Goat Research Unit, San Luis Experimental Station, National Institute for Forestry, Agriculture and Livestock Research (INIFAP), located at Palma de la Cruz, Soledad de Graciano Sanchez County (22°NL, 100°WL). The experiment considered 24 mature criollo does exposed

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to one month adaptation period to diet and facilities. Does were allocated according to their body condition score (BCS) into one of 4 experimental groups: Excellent (n = 6), Good (n = 6), Regular (n = 6) and Poor (n = 6).

Goats had free access to water and mineral salts (12% Ca, 12% P) and received a complete mixed diet in individual pens (1.0×1.2×0.6 m). Each group received a different diet according to BCS. Diets were formulated considering pen-fed conditions, minimal activity and early pregnancy requirements (NRC, 1989). Once placed in their experimental group according to an initial BCS, diets were adjusted every 14 day based on BCS in order to avoid increase or decrease of weight. Classification of BCS considered the dorsal palpation technique (Honhold *et al*., 1991), were BCS ranged from 1-4, 1 = very thin and 4 = obese.

Blood samples were collected (0700) on late February, early April, late May and early June to evaluate serum leptin concentrations in the Endocrinolgy Laboratory of the Academic Unit of Veterinary School, Zacatecas Autonomous University. A solid-phase radioimmunoassay technique was used to determine serum concentration of leptin, using a commercial kit (LINCO®). This method uses I^{125} exclusive anti-serum for determination of leptin concentration in plasma or blood serum in human and several species considering the double antibody/PGE technique. Assay procedures and reagents were included in the kit and samples were assayed as described by the supplied protocol. Intra-assay coefficient variation was 8.8%, inter-assay of 9.0% and a detection limit of 0.5 ng mL. Guinea pig anti-serum and standard concentration of 1, 2, 5, 10, 20 and 50 ng mL^{-1} of a recombination of pure human leptin were used. The effect of BCS on reproductive activity was analyzed in a 4×6 factorial design (PROC MIXED; SAS, 1999), where factor A was BCS treatment, factor B was blood sample collection date and doe as a repeated measures.

RESULTS AND DISCUSSION

Serum leptin concentrations differed ($p<0.05$) among treatments, with average concentration levels of 1.81, 6.6, 8.6 and 8.7 ng mL^{-1}, for BCS1, BCS2, BCS3 and BCS4 respectively, without differences between BCS3 and BCS4. Figure 1 shows serum leptin concentrations according to sampling date, without differences ($p>0.05$) among sampling dates. Serum leptin concentration was positively correlated to BCS, which agrees with previous results carried out in ruminants (Blache *et al*., 2000; Delavaud *et al*., 2002; Archer *et al*., 2002; Zhang *et al*., 2005). In humans (Considine *et al*., 1996) and ruminants

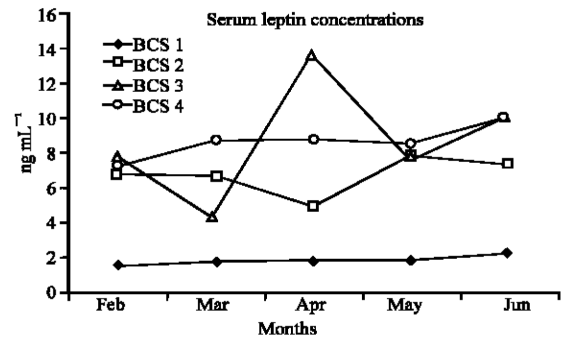

Fig. 1: Average leptin concentrations (ng mL^{-1}) during late February, early April, late May and early June in criollo goats assigned to four body condition scores (BCS) and under increased photoperiod in central Mexico (22 NL)

(Delavaud *et al*., 2002) leptin synthesis in the adipose tissue has been positively related to the number and size of adipose cells. In cows, this relationship explained 50% of the variation in leptin values, being the BCS a good predictor of serum leptin levels (Delavaud *et al*., 2002).

In most species, leptin concentration is closely related to short term changes in energy instead of long term changes of adipose tissue stores (Schneider *et al*., 2000). In fact, leptin levels change more quickly than the levels of body fat stores in response to changes in energy balance, such as in fasting and cold exposure (Schneider *et al*., 2000). Henry *et al*. (2004) reported that after a 32-h fasting period, leptin plasmatic concentrations decreased in obese sheep, but not in thin sheep. Moreover, in sheep receiving 2X-maintenance, it was observed a higher increase in leptin concentrations in obese sheep when compared to slim sheep (Zhang *et al*., 2005). The last could be explained since fat animals have more fatty cells and of greater size, which could generate larger response to changes in energy balance.

The nutritional state is closely regulated by neuroendocrine and hormonal cues and energy restriction produces harmful consequences in growth, reproduction and other metabolic processes, throughout the effect of some neuroendocrine hormones such as leptin which has a deep effect in food intake (Legardi *et al*., 1997). In fact, several studies support the hypothesis that leptin acts inside the hypothalamus influencing the activity of some neuropeptides involved in food intake regulation and energy expenditure, including the neuropeptide Y (NPY) and corticoid releasing hormone (CRH) (Campfield *et al*., 1995). While, NPY increases food intake and decrease energy expenditure (Billington *et al*., 1994), CRH makes a contrary action (Krahn *et al*., 1998). Therefore, during fasting periods, low leptin levels increase NPY production and food intake is stimulated, while energy expenditure decreases. In fact, when facing starvation animals protect their energy reserves in order to warrant their survival for a longer period of time (Schneider *et al*., 2000).

According to García *et al*. (2002), body weight has an important participation in the onset of puberty and leptin plasmatic levels were related to weight variations; leptin concentrations increased linearly during 16 weeks prior to the first ovulation. Short term food deprivation affects reproductive performance in domestic animals by reducing gonadotropin secretion in pigs (Mao *et al*., 1999), sheep (Nagatani *et al*., 2000) and beef (Amstalden *et al*., 2000). In fact, fasting can alter ovarian function causing a reduction of LH receptors and estrogen synthesis by granulosa cells (Spicer *et al*., 1992). Once again, leptin could be the key signal molecule, since females with low leptin levels are anovulatory and fertility can be restored in mature animals treated with leptin (Chehab *et al*., 1996).

CONCLUSION

Results of this study demonstrated that body condition score of adult-multiparous goats affected serum leptin concentrations in a direct and proportional way; the better the BCS the greater serum leptin concentration. Results should help to understand adaptation mechanisms exerted by goats facing a marginal nutritional support. The last could be of economic significance especially in criollo goats managed under semi-arid conditions, in which scenarios of restricted nutrition prevail.

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