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Relationship of Serum Leptin Concentration to Fat Deposition in Slaughtered Young Camels

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Abstract: Body weight, back-fat thickness and serum leptin concentration were measured in a total of 166 young camels. Serum concentration of leptin increased linearly with body fat and age and highly correlated with back-fat thickness, suggesting that serum leptin content is a good indicator of body fatness in camels.

Key words: Leptin, back-fat thickness, camels, ruminants, meat, Saudi Arabia

INTRODUCTION

Leptin, the product of the obese (ob) gene, is a 16 kDa hormone that has been shown to play an important role in the regulation of food intake, energy expenditure and hypothalamus endocrine function in response to nutritional changes (Friedman, 1998; Elmquist *et al*., 1999; Al-Azraqi, 2006). In mammals, leptin is expressed primarily in adipose tissue (Zhang, 2004) and at a lower level in the placenta and stomach (Masuzaki *et al*., 1997; Bado *et al*., 1998). Leptin is mainly secreted from white adipose tissue and its levels in circulation are correlated with fat mass in human, rodents (Muffei *et al*., 1995) and ruminants (Chilliard *et al*., 2001). Leptin gene, its protein product and receptor have been identified (Dyer *et al*., 1997, 1997) and intra cerebroventricular injection of leptin decreased food intake and body weight in sheep (Henry *et al*., 1999; Tokuda *et al*., 2000). Plasma leptin concentration was highly correlated to adipocyte volume and higher in overfed than in underfed cows (Delavaud *et al*., 2002). Additionally, Blache and colleagues found that plasma leptin concentration was highly correlated with back fat thickness and with ratio of back fat thickness to live weight in sheep (Blache *et al*., 2000). Furthermore, plasma leptin concentrations increased with fattening and correlated with plasma insulin concentration (Tokuda and Yano, 2001; Tokuda, *et al*., 2001).

In human, it was reported that leptin concentrations of newborns after birth declined rapidly and were extremely low by approximately 6 days of life (Matsuda *et al*., 1999). The decline in circulating leptin after birth may be a signal to commence feeding. In ruminants, the digestive system of the newborn in functionally similar to that of monogastric animals. On the other hand adult ruminants utilize volatile fatty acids (VTAs) evolved by rumen fermentation instead of glucose as major substrate for energy and are at most totally dependent on gluconeogenic pathway for provision of glucose in the fed state as well as during fasting (Ballard *et al*., 1969), therefore, plasma glucose and insulin concentrations in ruminants hardly change post prandially unlike monogastric animals. However, little is known about either changes in circulating leptin concentration and of leptin just after birth or the effect of weaning on plasma leptin concentration in ruminants or camels. Serum leptin is also sensitive to energy balance and is reduced during periods of negative energy balance in sheep. The injection of recombinant leptin reduced food intake and body fat content and increaed energy expenditure in mice (Campfield *et al*., 1995; Halaas *et al*., 1995). In beef, cattle plasma leptin concentration correlated with marbling score and rib-eye fat thickness (Minton *et al*., 1998) and back fat thickness in sheep (Blache *et al*., 2000). In newborn ruminant ingested milk is conveyed directly to abomasums, digested and glucose is utilized as a substrate for energy. Consumption of solid food during the suckling period triggers development of the rumen in newborn lambs as it adapts to solid food. The transition from the pre-ruminant to ruminant state contributes to changes in the secretion pattern of circulating insulin and glucose in lambs (Ballard *et al*., 1969; Johns and Bergen, 1976). Therefore, circulating leptin level might be affected by the change from the pre-ruminant to ruminant state. Like wise, adipose volume of subcutaneous and perirenal depots increases after weaning (Arana *et al*., 1998). Consequently, plasma leptin has been found to be positively correlated with body mass index and body fat in humans Hosoda, *et al*., 1996). Adipose cell volume is reported to increase with live-weight gain (Hood and Thornton, 1979). It is possible that serum leptin, immediately after weaning, will mirror the accumulation of fat.

In many countries where camels' meat is edible, people prefer meat of young camels as it is of better taste and contains less amount of fat compared to adult camels meat. The optimal age of young camels for slaughtering is difficult to define. Therefore, this investigation was conducted to determine the time of onset of fat deposition in young camels and its relationship to body weight, age and serum leptin concentration.

MATERIALS AND METHODS

Animals: Young camels (n = 166) from the camels that were brought to Al-Ahsa abattoir were initially weighed, their age was estimated and blood samples were collected. Serum was separated and stored at -20°C until analysis for leptin. After slaughter, subcutaneous back-fat thickness was measured on the 12th rib according to the method described by Gooden *et al.* (1980). This non-invasive measurement correlated with body condition score (r = 0.82) and is a good predictor of carcass fat percentage.

Leptin assay: Leptin was determined using RIA Kit (Mutli-Species Leptin RIA Kit, Linco Research, St. Charles, MO) according to manufacturers recommendation (Al-Azraqi, 2006). Human leptin as standard and antiserum against guinea pig leptin were used in the assay. The log dose-response parallelism of camel plasma with the human leptin were tested by comparing their slopes (Tallarida and Murray, 1981) which did not differ significantly (tabular value 2.33, $p<0.01$). The limit of sensitivity was 0.5 ng mL^{-1}. The intra- and inter-assay coefficients of variation were 4.3 (n = 11) and 5% (n = 10), respectively.

Statistical analysis: The relationship between concentration of leptin and back-fat thickness was quantified by Pearson correlation coefficients.

RESULTS AND DISCUSSION

A total of 166 young camels were included in this study. Their body weight, age, back-fat thickness and serum leptin concentration are shown in Table 1. Back-fat thickness increased with increasing body weight and age. Values of back-fat thickness doubled at 8-9 months of age

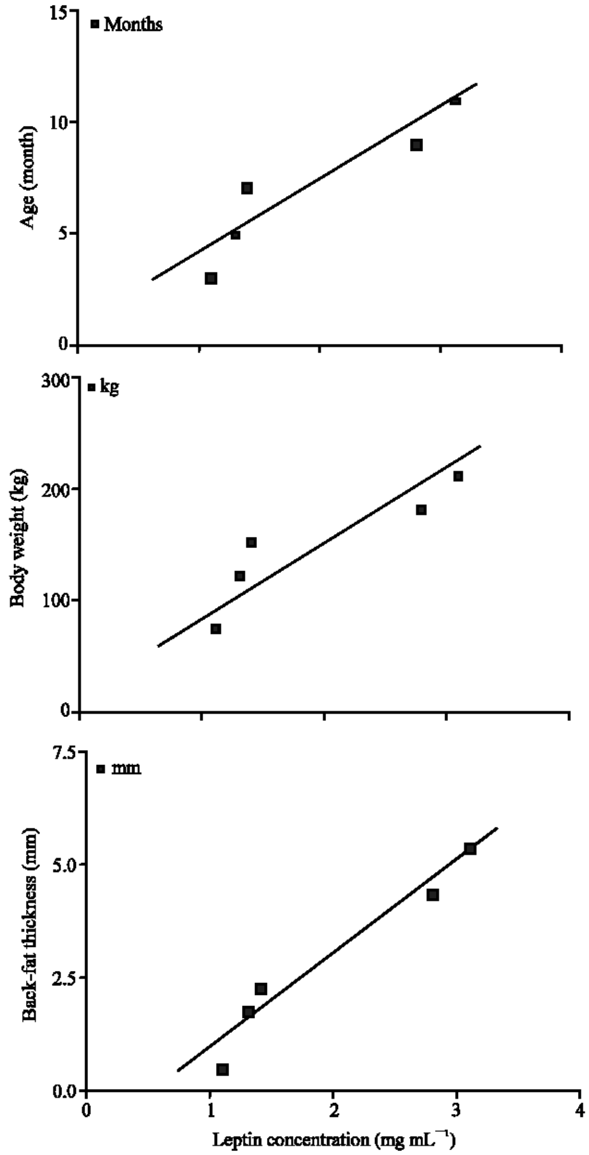

Fig. 1: Illustrating the relationship between serum leptin hormone concentration in slaughtered young camels of this study (n = 166) and the change in their a) age, b) body weight and c) the back-fat thickness

when animals attained 180 kg of body weight. Serum leptin concentration increased linearly with increasing back-fat thickness. Serum leptin was also positively

Table 1: Mean±(SD) body weight, age, back-fat thickness and leptin hormone concentration in slaughtered young camels (n = 166)

Variable	Unit	Range of variables				
Body weight	kg	75±5	120±8	150±8	180±10	210±10
Age	months	2-3	4-5	6-7	8-9	10-11
Back-fat thickness	mm	0.5±0.11[a]	1.8±0.13[b]	2.3±0.21[b]	4.4±0.22[c]	5.4±0.31[c]
Leptin conc	mg mL^{-1}	1.1±0.1[a]	1.3±0.2[a]	1.4±0.2[a]	2.8±0.2[b]	3.1±0.3[b]

[a-c] Different superscripts within rows are different ($p<0.05$)

correlated with back-fat thickness (r = 0.81, $p<0.001$), with age (r = 0.69, $p<0.05$) and with body weight (r = 0.71, $p<0.01$) as illustrated in Fig. 1.

In young camels, back-fat thickness significantly increased as body weight attained 180 kg. Likewise, serum leptin concentration linearly increased and well correlated with back-fat thickness.

Leptin concentrations were also highly correlated with 10th rib fat depth in cattle (Minton *et al*., 1998; Geary, 2003), sheep Delavaud *et al*., 2000), pigs (Estiene *et al*., 2000) and horses (Buff *et al*., 2002). It was suggested that the increase in plasma leptin concentration in obese animals is due to an up-regulation of leptin gene expression, linked to an increase in the number and size of fat cells, rather than to an alteration in leptin clearance (Delavaud *et al*., 2000; Considine *et al*., 1996; Klein *et al*., 1996) The fact that an increase in body fat could be translated into an increase in plasma leptin through adipocyte hypertrophy is in agreement with positive relationship between plasma leptin and adipocyte volume in the cow Chilliard *et al*., 1998). Thus, plasma leptin content is a good indicator of body fatness in camel (present work), cattle (Chilliard *et al*., 1998), sheep (Dalavaud *et al*., 2000), rodents and humans (Maffei *et al*., 1995).

If the pattern of deposition of fat is considered in conjunction with the increase in serum leptin concentration, then it is likely that camels slaughtered at body weight of 150-180 kg or at age of 7-9 months may provide meat that contains little fat. Furthermore, peripheral concentrations of leptin may ultimately become a useful live animal marker for identification of specific growth and carcass traits in camel.

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