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Regulation of glucose level during late pregnancy and onset of lactation in Egyptian female Baladi goats

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ABSTRACT

The present study aimed to evaluate the hormonal regulation of blood glucose level during late pregnancy and onset of lactation in Egyptian female Baladi does. Seven healthy female Baladi goats were used to study glucose levels and its hormonal regulation during late pregnancy and early lactation. Blood Samples were collected at late pregnancy (6, 5, 4, 3, 2, 1, weeks, and one day before parturition); day of parturition and early lactation (1, 2, 3 and 4 weeks after parturition). Plasma cortisol, insulin and glucose were determined. The obtained results revealed that plasma cortisol remained low during late pregnancy and then increased significantly ($P < 0.05$) one day before parturition then decreased on the day of parturition and remained low for one week after parturition. Cortisol level increased markedly at 2, 3 and 4 weeks after parturition. Plasma insulin remained low at 6, 5, 4 and 3 weeks prepartum. A significant increase was noticed at 2 weeks, 1 week and one day before parturition. Insulin concentrations decreased markedly on the day of parturition, then increased ($P < 0.05$) during the postpartum period. Plasma glucose concentrations remained low during late pregnancy then increased at one day before parturition, on the day of parturition and remained elevated during postpartum period. It could be concluded that late pregnancy and early lactation in does were accompanied by significant changes in plasma cortisol, insulin and glucose concentrations. Glucose levels during late pregnancy and early lactation are highly correlated with cortisol and less correlated with insulin. The results obtained point out justification of administration of cortisol. This will help in treatment of pregnancy toxaemia in does and ensure good health during the very demanding physiological states of late pregnancy and early lactation.

1. Introduction

There are many studies on the effect of pregnancy and lactation on biochemical blood parameters (Iriadam, 2007; Tanritanir et al., 2009). Pregnancy, parturition, and lactation represent a physiological load to the female body. Pregnancy toxaemia caused by negative energy balance in late gestation is commonly observed in ewes and does (Kulcsar et al., 2006). Ewes bearing more than 1 fetus are more susceptible to pregnancy toxaemia than those with a single fetus (Sargison, 2007; Moallem et al., 2012). Late pregnancy and onset of lactation are considered metabolic stress. Goats are at risk of developing pregnancy toxaemia at the end of gestation and during early lactation (Smith and Sherman, 1994). Pregnancy toxaemia is a potential fatal metabolic disorder noticed in stressed pregnant ewes carrying multiple foeti during the last 2–4 weeks of gestation (Wierda et al., 1985; Buswell et al., 1986; Smith, 1990).

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The ruminant must supply most of its needed glucose via gluconeogenesis (Swenson and Reece, 1993). It does this by using the absorbed nutrients such as propionate and the glycogenic metabolic products that can be recycled into glucose. These metabolites come from glucogenolysis from amino acid deamination and from triglyceride hydrolysis.

In underfed ewes, hypoglycaemia during late pregnancy is associated with decreased plasma insulin and increased plasma growth hormone (Blom et al., 1976; Mellor et al., 1987). Because normal plasma glucose levels are close to the threshold for stimulation of insulin release, it seems that central neural mechanisms like those mediating responses to more acute hypoglycaemic stress; may be involved (Havel and Taborsky, 1989).

Glucose levels are higher during lactation when compared with levels observed near parturition (Bergman and Hogue, 1967). Speedy (1992) suggested that there may be fundamental differences between pregnancy and lactation in the way of glucose homeostasis.

Bassett (1986) has reported changes in plasma cortisol following insulin-induced hypoglycaemia in pregnant ewes. Moreover, addition of cortisol to noradrenaline infusion resulted in a slow but continuous increase in plasma glucose and insulin concentrations (Speedy, 1992). One of the important factors is physiological status, which affects concentration of indicators in blood that are involved in the development of the blood metabolic profile (Antunović et al., 2002; Roubies et al., 2006).

The aim of this study is to determine the hormonal regulation of blood glucose level during different physiological states in Baladi does.

2. Materials and methods

Seven apparently healthy female Baladi goats, 2.49 ± 0.42 years old, with a mean body weight 29.57 ± 0.45 kg, were used. The does were clinically normal and free from both internal and external parasites. Animal used in this study were maintained at the same environmental conditions in Sakha farm, Kafrelsheikh Governorate throughout the experimental period, extended from November 2012 to May 2013.

Animals were fed a constant diet composed of berseem and pelleted concentrate mixture (corn (32%), bran (33%), cotton seed cake (34%) and sodium chloride 1%) throughout the experimental period during pre- and postpartum to overcome any effect of diet on the measured parameters. Each doe provided with 0.5 kg of concentrate twice daily (08:00, 20:00) in addition to 2 kg berseem. Water was offered ad libitum. The does were exposed to fertile buck during estrus and the mating date was recorded.

Blood samples were collected from jugular vein at 7 AM before feeding at 6, 5, 4, 3, 2, 1 week and one day before parturition; day of parturition and 1, 2, 3 and 4 weeks after parturition. Heparinized blood samples were taken then plasma was separated and stored at −20 °C until hormonal analysis. For glucose estimation, blood samples were collected on sodium fluoride and plasma glucose was estimated within 24 h, the intra-assay coefficient of variation was 7.64%. Plasma cortisol was estimated by R.I.A. according to Bocking et al. (1986). The intra-assay coefficient of variation (CV %) was 21.03%. Plasma insulin was determined by R.I.A according to Wilson and Miles (1977). The intra-assay coefficient of variation was 12.68%. Cross reaction test was performed to determine the suitability of the kit used for goat plasma. Plasma glucose was estimated colorimetrically using a glucose kit according to a method by Trinder (1969). The intra-assay coefficient of variation was 7.64%.

The results were statistically evaluated using Duncan's multiple range tests (Statistica, 2008). Differences were considered significant at the level of 0.05 or less.

3. Results

Plasma cortisol concentration remained low during late pregnancy (Table 1 and Fig. 1). Cortisol levels then significantly increased ($P < 0.05$) the day before parturition. On the day of parturition, cortisol declined, but concentrations were still higher than prepartum levels. One week after parturition cortisol levels returned to prepartum levels. Cortisol concentrations increased 2–4 weeks postpartum to levels that were significantly ($P < 0.05$) higher than levels observed prepartum (Table 1).

Insulin levels remained low at 6, 5, 4 and 3 weeks before parturition, then a significant ($P < 0.05$) increase noticed at 2 weeks, 1 week and one day before parturition. On the day of parturition insulin concentration, significantly ($P < 0.05$) decreased then increased during 1, 2, 3 and 4 weeks postpartum (Table 1 and Fig. 1). The correlation coefficient showed a high correlation

Table 1
Concentration of cortisol, insulin and glucose (means ± SD) related to the time of parturition in Egyptian in female Baladi goats.

Time related to parturition		Cortisol (ng/ml)		Insulin (μU/ml)		Glucose (mg/dl)	
		Mean ± SD	% CV	Mean ± SD	% CV	Mean ± SD	% CV
Weeks Before Parturition	6th	$1.73^{e} \pm 0.36$	20.81	$8.14^{e} \pm 1.06$	12.97	$42.14^{e} \pm 9.84$	23.35
	5th	$1.70^{e} \pm 0.36$	21.18	$7.44^{e} \pm 0.82$	10.97	$42.29\ e \pm 4.36$	10.30
	4th	$2.99^{de} \pm 0.52$	17.26	$8.81^{e} \pm 1.16$	13.21	$40.57^{e} \pm 3.79$	9.35
	3rd	$1.52^{e} \pm 0.19$	12.63	$10.98^{de} \pm 1.18$	10.71	$41.86^{e} \pm 1.68$	4.01
	2nd	$2.55^{e} \pm 0.54$	21.18	$14.3^{cd} \pm 1.99$	13.93	$40.86^{e} \pm 2.27$	5.55
	1st	$2.50^{e} \pm 0.55$	22.08	$22.22^{ab} \pm 2.04$	9.18	$48.00^{de} \pm 2.32$	4.83
	CV %		19.19		11.83		9.56
One day before parturition		$23.59^{a} \pm 10.36$	43.90	$17.51^{bc} \pm 2.86$	16.31	$77.33^{a} \pm 3.36$	4.35
Day of parturition		$9.03^{b} \pm 1.92$	21.26	$11.82^{de} \pm 1.60$	13.50	$75.86^{a} \pm 5.12$	6.75
	CV %		32.58		14.91		5.55
Weeks after parturition	1st	$2.32^{e} \pm 0.55$	23.79	$17.73^{bc} \pm 2.36$	13.33	$53.57^{cd} \pm 4.31$	8.04
	2nd	$7.80^{bc} \pm 1.07$	13.69	$19.40^{ab} \pm 2.72$	14.04	$56.86^{bc} \pm 3.77$	6.63
	3rd	$6.91^{c} \pm 0.98$	14.24	$23.86^{a} \pm 2.58$	10.81	$61.43^{b} \pm 3.30$	5.37
	4th	$4.59^{d} \pm 0.94$	20.39	$18.99^{bc} \pm 2.51$	13.21	$60.71^{bc} \pm 1.88$	3.10
	CV%		18.03		12.85		5.79
Intra-assay CV% (average % CV)			21.03		12.68		7.64

Means of the same column sharing different superscripts are significantly different ($P < 0.05$).