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Blood biochemical and hormonal profiles *vis-a-vis* production performance of single and twin kid bearing Surti goats (*Capra hircus*)

K.C. Gamit*, T.K.S. Rao, N.B. Patel, N. Kumar, S.S. Chaudhary, T.H. Solanki and T.D. Manat

Department of Livestock Production Management,
College of Veterinary Science and Animal Husbandry, NAU, Navsari 396 450, Gujarat, India
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ABSTRACT

Study was undertaken to investigate the effect of single and twin kidding on blood bio-chemical, hormonal profiles and production performance of 14 goats. The animals were divided into group1 (single kid, n=7) and group 2 (twin kids, n= 7). The blood samples were collected on 0, 7, 15, 30, 45 and 60 day of parturition for analysis of blood profiles. Milk yield and fat% were also recorded on different test days. Serum glucose, albumin, BUN and cholesterol was higher in twin bearing dam; however, it was not significantly ($P<0.05$) different. Overall total protein and NEFA was higher in singlet bearing goats on 0 and 45 days of parturition. Cortisol was significantly ($P<0.05$) higher in singlet bearing goats initially (7d) during kidding, however overall cortisol level was higher in twin bearing dams, indicating fast recovery of stress in singlet bearing goats. Level of estrogen was also higher in twin bearing goats. Milk yield was significantly higher in twin bearing goats. It was therefore inferred that kidding pattern had a marked influence on blood profiles and production performance in Surti goats.

Key words: Blood glucose, Cortisol, Estrogen, Milk yield, NEFA.

INTRODUCTION

Goat (C*apra hircus*) is truly called as the poor man's cow which provides a farmer with milk, manure and protein rich meat. Goat is gaining recognition in backyard farming because of less space requirements and production efficiency that is better than cattle. Prolificacy (twining & triplets) is common in goats. Release of fetus at parturition involves interaction of different hormones. More placental tissue in twin goats is associated with high placental lactogen secretion and mammary gland development (Anderson *et al*., 1981). Blood profiles and production performances vary with twin or single fetus in goat (Khan and Ludri, 2002a). Blood components like glucose, proteins, urea and NEFA (Non esterified fatty acid) can be considered as a marker to assess energy, health and nutritional status of animals (Gupta *et al.*, 2008). Post-parturient phase is characterized by changes in blood profiles along with reduction in feed intake when requirement due to awaited milk synthesis is increasing. Increase in energy requirement during lactation usually produces increase in serum NEFA (Mannat *et al*., 2016) which ultimately maintains caloric homeostasis of body. High plasma NEFA during late pregnancy were associated positively with total fetal biomass (Reid and Hinks, 1962). No detailed study has been carried out on the level of blood metabolites and hormones during post-parturient period bearing singlet or twin kids in Surti goats.

MATERIALS AND METHODS

14 cycling Surti goats in first to fifth lactation were selected from LRS, Veterinary College Navsari goat herd during October to April 2016. Goats were selected on the basis of kidding pattern (7 singlet bearing in group I and 7 twins bearing in group II). Birth weight of kid varied from1.5 to 2.5 kg. Experimental goats were kept in goat pen with pucca shed and concrete flooring. Feeding was done as per ICAR standards, 1998. All animals were in initial phase of lactation, identified by ear tag system, milked once on test days using measuring cylinder. The blood samples were collected on day of kidding, 7^{th}, 15^{th}, 30^{th}, 45^{th} and 60^{th} days post-partum prior to feeding. Serum from clotted blood was separated and stored at -20°C in deep freeze until analyzed for biochemical parameter and hormonal assay. Hemoglobin was estimated by fully Automatic Heamatology cell counter. Serum glucose, protein, BUN (Blood Urea Nitrogen), cholesterol and albumin concentration was estimated by Glucose oxidase (GOD-POP), Biuret, GLDH, CHOD-PAP (Monoreagent) and BCG method respectively. NEFA concentration was estimated by free fatty acid quantitation. Serum Cortisol and estradiol concentration was measured by standard Enzyme Linked Immuno Sorbent Assay. All parameters were estimated by assay kits. Data were analyzed using student's t-test and DMRT for comparison of mean.

RESULTS AND DISCUSSION

Blood metabolites: The overall mean values of glucose in Surti doe was higher in twin as compared to singlet bearing group however difference was not statistically significant ($P>0.05$) (Table-1). Similar to our finding Hussien *et al*. (1996) reported increase in blood glucose in twin as

*Corresponding author's e-mail: krishna29692vet@gmail.com

Table 1: Mean ± SE of Blood-biochemical profiles of Surti goats during post-partum periods

Parameters	Groups	Days 0	7	15	30	45	60	Overall
Glucose(mg/dl)	Singlet	72.37±0.81^{c}	72.03±0.76^{c}	62.87±0.51^{b}	59.11±0.31^{a}	58.45±0.75^{a}	62.03±0.58^{b}	64.48±0.91
	Twin	73.89±0.38^{d}	74.15±0.30^{d}	63.46±0.55^{c}	61.21±0.07^{b}	58.19±0.79^{a}	63.02±0.89^{c}	65.65±0.98
	Over all	73.01±0.45	73.09±0.49	63.16±0.37	60.16±0.32	58.32±0.52	62.52±0.5	65.06±0.93
Total protein(gm/dl)	Singlet	6.83±0.12^{b}	6.17±0.17^{a}	6.94±0.04^{b}	6.94±0.04^{b}	**6.88±0.03^{b**}**	7.17±0.16^{b}	6.80±0.06
	Twin	6.88±0.19^{ab}	6.14±0.19^{a}	6.88±0.19^{ab}	7.08±0.26^{b}	**6.70±0.25^{a**}**	7.03±0.34^{b}	6.78±0.10
	Over all	6.85±0.11	6.15±0.11	6.84±0.11	7.01±0.12	6.79±0.92	7.10±0.18	6.79±0.09
Albumin(Gm/dl)	Singlet	1.30±0.24^{a}	1.34±0.22^{a}	3.29±0.15^{c}	2.70±013^{b}	2.19±0.09^{b}	2.49±0.18^{b}	**2.22*±0.13**
	Twin	2.64±0.11^{ab}	2.65±0.11^{ab}	3.04±0.15^{b}	2.73±0.12^{ab}	2.33±0.11^{a}	2.46±0.20^{a}	**2.64*±0.06**
	Over all	1.87±0.23	1.99±0.22	3.17±0.11	2.71±0.08	2.26±0.07	2.47±0.13	2.43±0.08
BUN (mg/dl)	Singlet	9.08±0.74^{a}	7.9±0.88^{a}	9.30±0.76^{a}	10.25±1.22^{a}	10.68±1.06^{ab}	13.55±1.30^{b}	10.13±0.47
	Twin	9.6±1.66^{a}	8.19±1.74^{a}	9.45±1.69^{a}	10.37±0.96^{a}	11.09±2.79^{a}	14.83±1.30^{b}	10.59±0.63
	Over all	9.41±0.87	8.06±0.93	9.37±0.89	10.31±0.74	10.88±0.72	14.19±0.90	10.36±0.56
Cholesterol (mg/dl)	Singlet	68.31±6.98^{ab}	82.76±3.79^{b}	71.36±6.50^{ab}	68.39±5.03^{ab}	69.91±5.11^{ab}	62.16±5.47^{a}	70.48±2.34
	Twin	72.78±4.41^{a}	85.96±5.94^{b}	71.64±4.52^{a}	69.33±6.04^{a}	68.27±2.87^{a}	65.19±2.22^{a}	72.32±1.96
	Over all	70.83±3.98	84.36±3.41	71.50±3.80	69.32±3.47	69.79±2.82	63.68±2.86	71.40±2.14
NEFA(mmol/lit)	Singlet	**0.39±0.00^{e*}**	0.34±0.01^{d}	0.29±0.01^{c}	0.25±0.01^{b}	0.22±0.01^{ab}	0.19±0.01^{a}	0.28±0.01
	Twin	**0.38±0.01^{c*}**	0.35±0.01^{c}	0.28±0.02^{b}	0.14±0.01^{a}	0.18±0.01^{a}	0.15±0.01^{a}	0.24±0.01
	Over all	0.38±0.06	0.34±0.01	0.28±0.01	0.20±0.01	0.20±0.01	0.17±0.01	0.26±0.05

Mean bearing different superscript within same row differ significantly (abcde P <0.05)Mean bearing * within same column differ significantly (*P<0.05)

compared to singlet bearing goats. However Khan and Ludri (2002a) reported significantly (P<0.01) higher blood glucose level in twin-fetus bearing as compared to singlet bearing goats during postpartum period.

Values of glucose showed a decreasing trend from day 0 to 45 days and then increased on 60th day. Highest value was observed on day 0 and 7 in singlet and twin kid bearing goat respectively. Moreover, lowest glucose concentration was observed on 45th day in both types of goats. High glucose level around kidding followed by decrease during 2 week post-partum was also reported by Mannat *et al*. (2016) and Sadjadian *et al*. (2013). High glucose level on the day of kidding suggests physiological changes around parturition which endorse glycogenolysis and gluconeogenesis (Vazquez-Anon *et al*., 1994). High glucose level on day of kidding suggest high calorie protein ratio along with low circulating insulin level. Decreasing trend in glucose up to 45 days hint towards high energy need during initial days of milk production and its recovery after 45 days clearly strengthen the revival of feed intake which ultimately improves energy balance of body on 60 day.

The overall serum total proteins were higher in singlet kid bearing dams. The mean values of serum total protein was significantly (P<0.01) higher in singlet as compared to twin bearing goat on 45th day of parturition. However the significant increased level of total protein from 0 to 14 days as well as on 45th day post partum was reported by Manat *et al*. (2016). Lowest and highest value total protein was observed on 7th and 60th day respectively in both the groups. Increase in total protein on day of kidding may be due to increase in globulins resulting from formation of immunoglobulin and sudden decrease on 7th day suggests its release through colostrum to the suckling kid.

The overall mean values of albumin in Surti doe was significantly (P<0.05) higher in twins as compared to singlet bearing doe. The mean values of albumin in Surti doe were maximum on 15th day of parturition in both singlet and twin bearing goats. The albumin levels showed a significant decrease in the first 14 days after birth with a subsequent increase on 15th day. This trend reflects the albumin's medium half-life that ranges from 14 to 16 days in ruminants, after which period the liver is responsible for albumin synthesis (Kaneko, 2008; Thrall, 2004). Similar to our finding decrease in albumin 3 weeks post kidding was also reported by Mahmoud *et al*. (2014).

The overall mean values of BUN was higher in twins bearing dam as compared to singlet; however, the difference was not significant (P>0.05).

The lowest and highest value of BUN was observed on 7th and 60th day of parturition respectively in both the group. Serum BUN was higher in twin as compared to singlet bearing goats on different test days although the difference

was not significant. Blood urea increased significantly from 0 to 45th day of kidding in both the groups. Similar to our finding, the high level of BUN on 21st day post partum and lowest level around kidding has been reported by Sadjadian *et al*. (2013). The decrease in serum BUN around parturition may be associated with the decline in feed intake due to stress and hormonal changes during the kidding. In line with present result decrease in serum urea concentration during late pregnancy to early lactation has been reported by Celi *et al*. (2008).

The overall cholesterol value showed similar trend as BUN. The peak level serum cholesterol was observed on 7th day of parturition in both singlet and twin bearing group. Kaushish *et al*. (2000) observed the increasing tendency of cholesterol in the peri-parturient period which shows its role in the milk synthesis. In line with our finding in twin bearing goats, Hussein and Azab (1998) reported increase in cholesterol level at 2 and 3 weeks after parturition followed by a significant decrease at the fourth week post-partum also.

Overall value of NEFA showed similar trend as cholesterol and BUN. The mean values of NEFA in Surti doe was significantly (P<0.05) higher in singlet bearing group on day of parturition as compared to twin bearing group. The mean values of NEFA in Surti doe gradually decrease on 0 day to 60 day of parturition in both the groups. Peak level of NEFA concentration on the day of kidding followed by a decrease up to 60th days was also reported by Sadjadian *et al*. (2013) in Saanen does. Increase in lipolytic hormones near to parturition may be responsible for high NEFA concentration in blood. High NEFA indicate negative energy balance due to mobilization of fat to release high free fatty acid. High NEFA level also increases the rate of lipolysis in adipose tissue and is common in late pregnancy to early lactation. During post partum period the NEFA level higher in singlet as compared to twin fetus bearing goat as observed on 0 day was also reported by Khan and Ludri, (2002a).

Plasma hormones: The overall mean value of cortisol in Surti doe was higher in twins bearing goat even if it was not significant. Initially around kidding the serum cortisol was significantly (P<0.05) higher in singlet bearing goats as compared to twin bearing group on day 7 of kidding (Table-2) however, 15 day onward level of cortisol was higher in twins bearing goat, data trend showed noticeable ability of recovery of stress in singlet bearing goats. The mean values of cortisol in Surti doe decreased gradually from 0 day to 60 day of parturition in both singlet and twin bearing group. High level of cortisol in twins bearing as compared to singlet bearing doe was also reported by Khan and Ludri (2002[b]) despite the fact that they reported significant difference. High level of cortisol in twin bearing goats was indicative of stress of twin pregnancy on maternal side. The elevation of serum cortisol on day of kidding was in agreement to the findings

Table 2: Mean ± SE of Hormonal profile of Surti goats during post-partum periods.

Parameters	Groups	Days					
		0	7	15	30	45	60	Overall
Cortisol(µg/dl)	Singlet	3.62±0.13^{e}	**3.02±0.16^{d*}**	2.18±0.02^{c}	1.77±0.03^{b}	1.40±0.05^{a}	1.23±0.06^{a}	2.20±0.13
	Twin	3.34±0.12^{e}	**2.90±0.04^{c*}**	2.42±0.08^{c}	2.42±0.08^{c}	1.87±0.09^{b}	1.57±0.08^{a}	2.42±0.09
	Over all	3.47±0.09	2.96±0.08	2.30±0.05	2.10±0.10	1.64±0.08	1.40±0.07	2.31±0.07
Estrogen(pg/ml)	Singlet	60.56±5.23^{d}	55.43±4.31^{cd}	48.44±3.44^{bc}	45.32±3.11^{abc}	40.28±3.09^{ab}	35.53±3.14^{a}	47.60±1.97
	Twin	70.28±4.49^{c}	63.14±3.50^{bc}	58.65±2.88^{b}	46.21±2.75^{a}	43.47±2.80^{a}	36.95±3.58^{a}	53.12±2.24
	Over all	64.42±3.57	59.28±2.88	53.55±2.58	45.77±1.99	41.872.05	36.28±2.30	50.36±2.10

Mean bearing different superscript within same row differ significantly (abcde P <0.05)Mean bearing ***** within same column differ significantly (***** P<0.05)

of Khan and Ludri (2002b) as well as Suganya and Gomathy (2009). A significant increase in cortisol causes glycogenolysis in liver and mobilization of amino acid for gluconeogenesis. During the postpartum period the decline in the values of cortisol from 0 to 60 day were also reported by Mondal *et al*. (2014) in goats. Increase in serum cortisol on day of parturition and significant drop after 2 day parturition was also reported by Kumar *et al*. (2015).

The overall values of estrogen in blood of Surti does were higher in twin bearing group. Similar trend was observed on every test day also. The mean values of estrogen in Surti doe decreased gradually on 0 day to 60 day of parturition in both the group. The present finding showed higher level (over all 11.59% higher) of estrogen in twin pregnancy as compared to singlet on all test days although it was not significant. Dhindsa *et al.* (1981) also reported significantly higher estradiol in goats with multiple fetuses as compared to singlet fetus. Moreover Manalu *et al*. (1996) reported two times higher concentration of estrogen in twin bearing goats as compared to singlet bearing goats. However low level of estrogen was reported in twin pregnancy as compared to singlet pregnancy in crossbred goats by Khan and Ludri (2002[b]). Higher level of estrogen on the day of kidding was in agreement with Salah (1994). Pre-partum surge in estrogen on day of kidding is essential for starting protocol parturition i.e., uterine contraction and providing sympathetic stimulus for oxytocin and triggering prostaglandin release for myometrial contraction. High level of estrogen around parturition also associated with mammary gland preparation for lactation by stimulating prolactin secretion.

Hemoglobin: The overall mean value was higher in singlet bearing goats even though it was significant (Table-3). Increase in hemoglobin during the post partum period may be due to higher demand of oxygen and requirement of higher metabolic rate. Non-significant increase similar to our finding on 0 day and 7 day after kidding have been reported by Rejitha and Karthiayini (2014) in Malabari goats and -3 to +3 weeks kidding by Tharwat *et al*. (2013). However, significant decrease of hemoglobin on 14 day after birth has been reported by Alessandro *et al*. (2011).

Production: Production on 60d along with overall yield was significantly (P<0.05) higher in twins bearing goat (Table-4). Peak production was observed on 15[th] day. High production in twins bearing dam might be due to proper development of mammary gland and higher level of hormones related to lactogenesis. Similar finding was also reported by Hassan *et a*l. (2010). Overall fat percent in milk was also higher in twins bearing does though it was not significant as compared to singlet bearing goats. Peak fat% in milk was observed on 15[th] and 30[th] day in twins and singlet bearing does respectively.

Table 3: Mean ± S.E of Hemoglobin concentration of Surti goats during post-partum period.

Parameter	Groups	Days						
		0	7	15	30	45	60	Overall
Hemoglobin t (g/dl)	Singlet	6.4±0.05^{a}	6.8±0.07^{ab}	6.9±0.07^{ab}	9.0±0.25^{d}	8.2±0.40^{c}	7.5±0.30^{b}	7.50±0.16
	Twin	6.4±0.05^{a}	6.8±0.07^{a}	6.6±0.07^{a}	8.9±0.10^{c}	7.5±0.30^{b}	7.5±0.20^{b}	7.34±0.14
	Over all	6.4±0.00	6.9±0.00	6.8±0.10	9.00±0.13	7.9±0.27	7.5±0.19	7.42±0.11

Table 4: Mean ± SE of milk production of Surti goats during post-partum periods

Parameters	Groups	Days						
		0	7	15	30	45	60	Overall
Milk yield(g/d)	Singlet	485.71^{b}±98.63	314.28^{ab}±50.84	414.28^{b}±50.84	314.28^{ab}±40.40	285.71^{ab}±67.00	**185.71^{a*}±55.32**	**333.33*±28.44**
	Twin	557.14^{ab}±78.24	528.57^{ab}±99.31	714.28^{b}±137.02	500.00^{ab}±92.58	385.71^{a}±85.71	**414.28^{ab*}±76.93**	**516.66*±40.74**
	Over all	521.42^{bc}±61.28	421.42^{abc}±61.28	564.28^{c}±81.60	407.14^{abc}±54.93	335.71^{ab}±54.07	300.00^{a}±55.47	425.00± 26.66
Milk fat(%)	Singlet	3.92^{c}±0.16	2.95^{a}±0.16	3.11^{ab}±0.19	3.64^{bc}±0.12	2.92^{a}±0.14	3.32^{ab}±0.29	3.31±0.09
	Twin	3.61^{ab}±0.18	3.06^{a}±0.01	4.23^{b}±0.66	3.56^{ab}±0.07	2.90^{a}±0.05	2.86^{a}±0.10	3.37±0.13
	Over all	3.76^{b}±0.12	3.01^{a}±0.08	3.67^{b}±0.36	3.60^{b}±0.07	2.91^{a}±0.07	3.09^{a}±0.16	3.34±0.08

Mean bearing different superscript within same row differ significantly (abcd P<0.05)Mean bearing * within same column differ significantly (* P <0.05)

CONCLUSION

It was concluded that twin bearing goats had higher plasma glucose, BUN, cholesterol, albumin, estrogen cortisol and milk yield as compared to singlet bearing goats. The fluctuation in these hormones after parturition have influence on mammary gland development and stimulation with increase in number of kids in preparation for more synthesis and secretion of milk along with involution of uterus. High level of cortisol in singlet bearing goats initially around kidding followed by fast recovery to achieve overall less cortisol as compared to twin bearing goats. Number of kids born is having significant influence production performance and also showed marked changes in blood profile of goats.

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