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# Comparative Body Condition and Haemato-biochemical Profile of Tellicherry Does during Pregnancy, Lactation and Dry Period

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## ABSTRACT

**Background:** The aim of the study is to provide a complete picture of dynamics of body condition and selected hemato-biochemical parameters of Telicherry does during pregnancy, lactation and dry period.

**Methods:** Blood samples were collected from 40 Tellicherry does ageing around 2-2½ years fortnightly during early pregnancy (1-3 months), late pregnancy (3-5 months), early lactation, mid lactation, late lactation and dry period. Haematological parameters such as haemoglobin (Hb), packed cell volume (PCV), red blood cells count (RBC) and white blood cells count (WBC) were analyzed. Biochemical parameters such as lactate dehydrogenase (LDH), blood urea nitrogen (BUN), total protein (TP), glucose, triglyceride, aspartate transaminase (AST), calcium (Ca), phosphorus (P), sodium (Na) and potassium (K) were estimated.

**Result:** Significant reduction in body weight and condition was observed during early lactation followed by gradual increase during mid and late lactation. The levels of Hb, PCV, RBC ($P<0.01$) found to be elevated throughout pregnancy while WBC, BUN and total protein values were higher during late pregnancy and late lactation. However, LDH levels ($P<0.01$) were higher during both pregnancy and lactation. The serum levels of glucose and triglyceride were lowest during early lactation and highest during early pregnancy and dry period. Reduction in Ca and P ($P<0.01$) levels were observed throughout lactation. AST, Na and K levels remained unaffected during all the physiological status.

**Key words:** Biochemical parameters, Body condition, Haematological parameters, Physiological status, Tellicherry doe.

## INTRODUCTION

Among all species of farm animals, goats have the widest ecological range playing a significant role in providing supplementary income and livelihood to millions of poor and landless farmers. In the present scenario of changing agro climatic conditions, this small ruminant farm animal has tremendous potential to be projected as the 'Future Animal' for rural and urban prosperity. India occupies the first position in goat milk production (5.75 million MT), the second position in terms of goat population (148.88 million) and goat meat production (1041.11 thousand tons) in the world (FAO, 2008; NAPG, 2018; BAHFS, 2017). The goat sector contributes Rs. 14,453 crores to the agricultural economy of the country through meat, milk, skin, *etc*., which accounts for around 8 per cent of the gross domestic product (GDP) from the livestock sector. Besides, the goat sector generates about 4 per cent rural employment and about 20 million small and marginal farmers' and landless labourers' families depend on goats for their livelihood partially or completely.

The body condition indicates the amount of lipid (fat) and protein (muscle) reserves that are available for maintenance, reproduction and production. Body condition score (BCS) assessment in goats is beneficial to monitor the change in body reserves at various production stages throughout the year (Nawito, 2015). The most critical times to condition score goats are pre-breeding, early gestation, late gestation and early/peak lactation (Menzies, 2021).

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Hematological parameters are good indicators of physiological health status and its evaluation is important in assessing the response of animal to various physiological stressful conditions such as pregnancy, parturition and lactation (Manat *et al.* 2016).

Pregnancy and lactation are physiological statuses considered to modify metabolism in animals (Krajnicakova *et al.* 2003; Iriadam, 2007). During pregnancy, maternal tissues are involved in providing energy for reproduction processes, which may affect blood serum chemistry values (Swanson *et al.* 2004; Yokus *et al.* 2006). Blood biochemical parameters including total protein, triglycerides, free fatty acids and urea are important indicators of the metabolic activity in lactating animals (Karapehlivan *et al.* 2007). During lactation, the mammary gland secretory cells utilize 80% of the bloodcirculating metabolites for milk synthesis, depending on the speed of infiltration of precursors of milk compounds (*i.e.* free amino acids, glucose and fatty acids) (Nazifi *et al.* 2002). In lactating goats an increasing total protein level of serum was observed with the progress of lactation (Krajnicakova *et al.* 2003) due to the catabolism of protein for milk synthesis.

This study was attempted at providing a complete picture of dynamics of selected hemato-biochemical parameters of Telicherry goats during pregnancy, lactataion and dry period.

## MATERIALS AND METHODS

### Experimental location

The study was carried out at Livestock Farm Complex, Madhavaram Milk Colony, Tamil Nadu Veterinary and Animal Sciences University, Chennai, Tamil Nadu, India, located between latitudes 12° 9′ and 13° 9′ N and longitudes 80° 12′ and 80° 19′ E with an altitude of 22 m above MSL during the year 2019-2020.

### Experimental animals

40 Tellicherry does age around 2-2 ½ years were utilized for the study. All the does were maintained under intensive system of management with similar feeding, housing and health care.

### Experimental design

Bodyweight, body condition and blood samples were collected from the does at fortnight intervals during the different physiological status such as early pregnancy (1-3 months), late pregnancy (3-5 months), early lactation (1st month of lactation), mid lactation (2nd month of lactation), late lactation (3rd month of lactation) and dry period post lactation.

### Bodyweight and body condition

Bodyweight was recorded using a weighing balance. Body condition was assessed as per the protocol given by Villaquiran *et al.* (2004) with 0.5 increments.

### Haematological analysis

Blood samples were collected from the does by jugular venipuncture in both EDTA vacutainers and clot activating tubes for haematological and biochemical studies. Haematological parameters like haemoglobin (Hb), Packed cell volume (PCV), Red blood cells count (RBC) and White blood cells count (WBC) were analyzed using the automated haematology analyzer (Mindray - BC - 2800 VET, Shenzhen Mindray Bio-Medical Electronics Co., Ltd., China).

### Serum biochemistry

Blood samples collected in clot activating tubes were centrifuged at 3,000 rpm for 15 minutes for serum separation. Serum obtained after centrifugation was utilized or biochemical analysis. Biochemical parameters like lactate dehydrogenase (LDH), blood urea nitrogen (BUN), total protein (TP), glucose, triglyceride, aspartate transaminase (AST), calcium (Ca), phosphorus (P), sodium (Na) and potassium (K) were estimated using semi-automated biochemical analyzer (A-15 Biosystem Random Access Analyzer, Biosystem, Barcelona, Spain).

### Statistical analysis

The collected body condition and haemato-biochemical data were subjected to statistical analysis by one-way ANOVA using SPSS software. Treatment differences were considered significant at $P<0.05$. If significance was determined, Turkey's HSD was performed to differentiate between physiological statuses.

## RESULTS AND DISCUSSION

### Bodyweight and body condition

The impact of physiological status on the body weight and body condition of Tellicherry does is depicted in Table 1. The does exhibited higher body weight and body condition during pregnancy and dry period ($P<0.01$) than lactation. Sudden loss in body weight and condition ($P<0.01$) was noticed during the early lactation. However, gradual increase in the body weight and body condition was observed as the lactation advances and the does reached their pre-pregnancy body weight and condition in the dry period after lactation. Lactation was found to affect the body weight and body condition of the does profoundly.

BCS refers to fatness or muscle status of livestock and are commonly used for animal selection in the farms. Also, BCS levels of animals are related to reproductive performance and productivity (Serin *et al.* 2010). The lipid reserves of the animal changes during the breeding period, with an increase during pregnancy and mobilization at parturition and at the beginning of lactation (Bauman and Currie, 1980). Milk production generally reaches at peak at about six to nine weeks after kidding, however feed intake levels are not affected (Ghosh *et al.* 2019). It has been observed that goats are unable to eat enough to meet their energy need in early lactation, therefore, body fat reserves are mobilized to provide energy for high production (Cimen and Topcu, 2013) indicating that does are usually in a state of negative energy balance in early to mid-lactation (Ghosh *et al.* 2019) and have lowest BCS during peak lactation and there is negative relationship in between BCS and milk production (Ghosh *et al.* 2019). Similar to that reported earlier, the changes were also observed in the current study.

BCS of pregnant does in the present study were in accordance with Navarre *et al.* (2012) who stated that the pregnant goats should have a body condition score between 2.5 and 3. The changes in BCS during lactation period observed in the present study were in accordance with the results obtained by Darwesh *et al.* (2013) who observed a lower BCS in early lactation followed by significant ($P<0.05$) increase at mid as well as late stages of lactation. Similarly, Cabiddu *et al.* (1999) also reported that the BCS increased as the lactation progressed. However, the present BCS findings during lactation were higher than those observed by Sudharsan *et al.* (2020) who reported a BCS of 1.85±0.16, 1.95±0.09 and 2.15±0.16 in Tellicerry does during the early, mid and late lactation, respectively.

Body weight of Tellicerry does observed in the present study during early pregnancy was similar to that of Chitra *et al.* (2012) who reported a body weight of 24.23±0.73 kg in adult Tellicherry does. However, significant reduction in body weight was observed during the lactation period especially during early lactation due to fat mobilization and negative energy balance. Benchohra *et al.* (2015) also found a significant decrease in mean body weight during the first month of lactation in Rembi sheep. Ishmais *et al.* (2004) and Benchohra *et al.* (2015) also reported maximum loss in body weight during the first four week postpartum.

### Haematological parameters

Haematological parameters of Tellicherry does during the different physiological status is recorded in Table 2. The physiological status was found to have profound impact on the haematological parameters of Tellicherry does; however, all the haematological values were within the reference range for goats except for the WBC count. The haemoglobin (Hb) concentration, packed cell volume (PCV) and RBC count were found to be elevated during the late gestation period. Marked decrease in PCV, Hb and RBC count were noticed during the lactation period than during gestation. WBC count was elevated in all the physiological status. However, it was elevated greatly during late pregnancy and lactation ($P<0.01$) than during early pregnancy and dry period.

The elevated levels of Hb and PCV observed during the early and late gestation. Contrarily, marked decrease in concentration of PCV, Hb and RBC count was evident during the lactation period compared to pregnancy period. The results were in agreement with El-sheriff and Assad (2001). They observed an elevated PCV and Hb in Barki ewes from 10th week of gestation to parturition than dry period and a sharp decline in PCV and Hb during postpartum period. Salem (2017) also reported a significant reduction in RBCs, PCV and HB values were observed in lactating ewes and does. Hassan *et al.* (1982), who reported a low PCV and HB concentration in lactating animals, postulated a negative association between PCV and milk production. The elevation might be due to higher oxygen consumption to meet the requirements of high metabolic rate of pregnancy while the decline might be due to stress due to lactation on the life span of blood corpuscles and hemoglobin formation or hemodilution due to increased water mobilization to mammary glands through vascular system (El-sheriff and Assad, 2001). According to Anwar *et al.* (2012) elevated erythrocyte devastation in mammary cells are responsible for low PCV% along with mobilization of water to mammary gland.

Fortagne and Schafer (1989) reported an increase in the total leukocyte count in pregnant goats around parturition and Sandabe and Yahi (2000) also noted a significant increase in the leukocyte count of pregnant Sahel goats. The increase in total WBC in does during late pregnancy and lactation is because of the ACTH-related hormonal stress reaction (Oduye, 1976). According to Dellmann and Brown (1987) the stress probably stimulate the release of certain factors called leucocytosis inducing factor (LIF) and colony stimulating factors (CSF) which are known to increase haemopoietic activities and blood cells mobilization into circulation.

### Biochemical parameters

The biochemical parameters of the Tellicherry does were greatly affected by the different physiological status (Table 3).

**Table 1:** Body weight and condition of Tellicherry does (mean±S.E.) during different physiological status.

| Physiological status | Body weight (kg) | Body condition score |
|---|---|---|
| Early pregnancy (1-3 months) | 24.42$^{a}$±0.36 | 2.78$^{a}$±0.03 |
| Late pregnancy (4-5 months) | 25.14$^{a}$±0.53 | 2.74$^{a}$±0.06 |
| 1st month of lactation | 21.28$^{b}$±0.25 | 2.39$^{b}$±0.07 |
| 2nd month of lactation | 23.33$^{ab}$±0.71 | 2.41$^{b}$±0.03 |
| 3rd month of lactation | 23.35$^{ab}$±0.66 | 2.45$^{b}$±0.08 |
| Dry | 23.93$^{a}$±0.91 | 2.54$^{ab}$±0.08 |
| F value | 16.21** | 16.62** |

**Significant at P<0.01; Means bearing different superscript in the same row differ significantly.

**Table 2:** Hematological parameters (mean±S.E.) of Tellicherry does during different physiological status.

| Physiological status | Hb (g/dl) | PCV (%) | RBC ($10^6$/µl) | WBC ($10^3$/µl) |
|---|---|---|---|---|
| Early pregnancy (1-3 months) | 9.46$^{ab}$±0.11 | 25.42$^{ab}$±0.28 | 15.52$^{ab}$±0.23 | 17.90$^{b}$±0.76 |
| Late pregnancy (4-5 months) | 9.66$^{a}$±0.14 | 26.38$^{a}$±0.40 | 16.39$^{a}$±0.20 | 20.24$^{b}$±0.75 |
| 1st month of lactation | 8.69$^{c}$±0.21 | 24.00$^{bc}$±0.61 | 15.37$^{ab}$±0.32 | 19.84$^{b}$±1.18 |
| 2nd month of lactation | 8.50$^{c}$±0.21 | 23.32$^{c}$±0.63 | 15.06$^{b}$±0.37 | 20.30$^{b}$±1.31 |
| 3rd month of lactation | 8.77$^{bc}$±0.14 | 23.03$^{c}$±0.40 | 15.11$^{a}$±0.26 | 22.33$^{b}$±1.61 |
| Dry | 8.41$^{c}$±0.08 | 22.61$^{c}$±0.20 | 14.22$^{b}$±0.14 | 13.00$^{a}$±0.42 |
| F value | 21.34** | 24.27** | 14.60** | 3.15** |
| Reference range* | 8.0-12.0 | 22.0-38.0 | 8.0-18.0 | 4.0-13.0 |

**Significant at P<0.01; Means bearing different superscript in the same row differ significantly; *Reference range of Radostits *et al.* (2000) for goats.

Highest LDH concentration (P<0.01) above the reference range was observed during late pregnancy early lactation and mid lactation period followed by early pregnancy and late lactation. The end of gestation and the beginning of lactation are the two critical periods where most of the changes in serum metabolic profile happen. Higher LDH activity in mammary parenchyma is required during initiation of lactation (Visha *et al.* 2002). According to Bauman and Currie (1980) during the early lactation period, high-yielding cows can be in negative energy balance. Further, metabolic diseases with impact on the liver function most commonly occur during this period with changes in the activity of LDH and LDH iso-enzymes. Thus, the elevated LDH observed during the late gestation and early lactation period is due to initiation of lactation and negative energy balance.

Elevated BUN levels (P<0.01) were observed during late pregnancy and lactation period and has been reported as a good indicator of nitrogen intake in sheep and goats (Gurgoze *et al.* 2009). Animals may catabolize proteins in order to cover nutrient demand, which translates to increases in urea levels in plasma (Canfield *et al.* 1990). The elevated levels of BUN observed during the lactation were in accordance with Salem (2017) who reported elevated levels of BUN in lactating ewes and does. Berkani *et al.* (2018) also observed a significant increase in uraemia level at the 7th day of lactation compared with the last month of pregnancy in Djellal ewes. On the other hand, El-sheriff and Assad (2001) found that uraemia began to increase from the 10th week of gestation to maximum concentrations at parturition in Barki ewes under semi-arid conditions. Soliman (2014) also reported highest serum urea level during late-pregnancy followed by early-lactation than non-pregnancy. Karapehlivan *et al.* (2007) found that changes in blood urea concentration during lactation could depend on milk synthesis in Tuj ewes. The increase in BUN concentration is attributed to changes in protein metabolism during lactation (Salem, 2017) and higher urea concentration in lactating ewes can be a result of catabolizing muscle protein when large amounts of body reserves are mobilized (Antunovi *et al.* 2011).

The physiologic status (pregnant, dry and lactating) of animal plays a major role in regulating protein absorption and metabolism (Gonzalez *et al.* 1985). Serum total protein showed a significant increase during late pregnancy and lactation period than dry period. Similar results were reported by Piccione *et al.* (2009) in ewes during all (early, mid and end) lactation. Shetaewi and Daghash (1994) also pointed out a significant rise in serum total protein concentrations in lactating Egyptian coarse-wool ewes. According to Davson and Segal (1980) the ability to synthesize the constituents of milk appears 3-4 weeks prepartum. Thus, the elevated total protein during late pregnancy is attributed to the synthesis of milk constituents' prepartum. Further, in lactating goats total protein level of serum increases with the progress of lactation due to the catabolism of protein for milk synthesis (Krajnicakova *et al.* 2003). The higher value of total protein

**Table 3:** Biochemical parameters (mean±S.E.) of Tellicherry does during different physiological status.

| Physiological status | LDH (IU/L) | BUN (mg/dl) | TP (g/dl) | Glucose (mg/dl) | Triglyceride (mg/dl) | AST (IU/L) | Ca (mg/dl) | P (mg/dl) | Na (mmol/L) | K (mmol/L) |
|---|---|---|---|---|---|---|---|---|---|---|
| Early pregnancy (1-3 months) | $413.27^{a}\pm27.25$ | $20.26^{a}\pm0.39$ | $7.31^{ab}\pm0.10$ | $82.90^{a}\pm4.93$ | $43.78^{a}\pm1.80$ | 108.04±2.21 | $10.49^{a}\pm0.19$ | $8.80^{ab}\pm0.14$ | 149.70±0.39 | 5.71±0.07 |
| Late pregnancy (4-5 months) | $626.25^{b}\pm37.43$ | $23.73^{abc}\pm0.63$ | $7.81^{b}\pm0.10$ | $71.13^{ab}\pm1.80$ | $40.34^{ab}\pm2.18$ | 114.39±2.94 | $9.86^{ab}\pm0.32$ | $8.36^{ab}\pm0.20$ | 148.05±0.65 | 5.39±0.09 |
| 1st month of lactation | $764.61^{b}\pm63.40$ | $24.83^{c}\pm1.01$ | $7.75^{b}\pm0.16$ | $61.17^{b}\pm1.71$ | $30.26^{b}\pm3.39$ | 116.94±3.52 | $8.82^{b}\pm0.32$ | $8.03^{b}\pm0.37$ | 150.45±0.67 | 5.37±0.15 |
| 2nd month of lactation | $754.85^{b}\pm67.52$ | $24.71^{c}\pm1.35$ | $7.73^{b}\pm0.19$ | $63.29^{b}\pm1.73$ | $33.26^{ab}\pm2.23$ | 115.70±3.90 | $8.84^{b}\pm0.35$ | $8.12^{ab}\pm0.38$ | 145.85±5.13 | 5.48±0.14 |
| 3rd month of lactation | $444.52^{a}\pm63.84$ | $24.35^{bc}\pm2.11$ | $7.91^{b}\pm0.15$ | $70.90^{ab}\pm1.69$ | $36.91^{ab}\pm2.52$ | 113.43±4.25 | $8.78^{b}\pm0.41$ | $7.65^{b}\pm0.37$ | 150.09±1.11 | 5.39±0.16 |
| Dry | $240.21^{c}\pm11.90$ | $21.09^{ab}\pm0.40$ | $6.98^{a}\pm0.07$ | $71.57^{ab}\pm0.61$ | $43.41^{a}\pm1.20$ | 113.39±1.42 | $10.96^{a}\pm0.17$ | $9.20^{a}\pm0.14$ | 149.06±0.35 | 5.63±0.05 |
| F value | 47.87** | 8.04** | 12.77** | 4.79** | 4.10** | $1.48^{NS}$ | 10.13** | 6.38** | $1.66^{NS}$ | $2.64^{NS}$ |
| Reference range* | 123-392 | 12-26 | 6.2-7.9 | 50-75# | 21.4-42.8# | 0-300 | 9.2-11.6 | 4-11.2 | 135-156 | 3.4-6.1 |

NS - Non-significant; ** - Significant at P<0.01; Means bearing different superscript in the same column differ. significantly; *Reference range of Matthews (1999) for goats; #Kaneko *et al.* (2008).

in lactating does compared to dry also proves the high energy need which exists in animals due to milk synthesis especially during the early lactation (Bremmer *et al.* 2000).

The serum levels of glucose and triglyceride were lowest during the early lactation period and highest during the early pregnancy and dry period. Their levels started to decline as the pregnancy advances and a sharp decline in their levels were noticed during the early lactation period. However, as the lactation advances both glucose and triglyceride concentration increased steadily and reached the maximum level during the dry period. Wazirir *et al.* (2010) also observed a significant reduction in glucose levels as pregnancy advanced in sahel goats. This could be attributed to the considerable glucose requirements in pregnant animals (Parr *et al.* 1984). The lower level of blood glucose recorded during early stage of lactation may be ascribed to the utilization of large amount of blood glucose by mammary gland for the synthesis of lactose (Schultz, 1968).

Salem (2017) also observed a significant reduction in serum triglycerides levels in lactating ewes and does. Significant decrease in serum triglyceride during early and mid-lactation has also been reported by Gradinski-Urbanac *et al.* (1986) in sheep. During the lactation period, lipogenesis and esterification are reduced and free fatty acid mobilization is stimulated by an increase in nor-epinephrine and epinephrine secretion. The activity of lipoprotein lipase is increased in mammary gland and decreased in adipose tissue (Manat *et al.* 2016). According to Piccione *et al.* (2009) during lactation insulin triggered lipogenesis became incompetent and this drop in competency is manifested as reduction in serum triglycerides. Further, a strong evident suggests that in ruminants, during energy deficit the triglycerides drops (Mazur *et al.* 2009). The blood triglycerides are a major element in milk fat synthesis (Nazifi *et al.* 2002). During lactation phase, mammary gland uptake 80% of body metabolites to form milk (Ouanes *et al.* 2011). Thus, the reduction in triglyceride level during lactation is possibly due to incompetent lipogenesis and utilization of triglycerides for milk fat synthesis.

The AST levels remain unchanged during all the physiological status. The AST and ALT seem to be good predictors of level of amino acids utilization during gluconeogenesis and therefore of body protein depletion on negative energy balances (Caldeira and Portugal, 1991). Serum AST determinations are still part of many biochemical profiles because of their relatively high sensitivity for detection of hepatocyte injury and myocyte injury and stability in serum (Hoffmann and Solter, 2008). The results obtained in the current study were in agreement with the results of Kamalu *et al.* (1988) and Waziri *et al.* (2010), indicating that liver is not clinically affected during pregnancy.

Calcium level started to decline as the pregnancy advances and it reached its minimum during the first month of lactation ($P<0.01$). However, it started to increase gradually as the lactation advances and reached the normal physiological range during the dry period. Phosphorus level was lower during the early and late lactation however it was within the reference range.

Calcium (Ca) and Phosphorus (P) are the major minerals, mainly stored in the skeleton and are very strongly mobilized at the beginning of lactation (Berkani *et al.* 2018). Similar to that of the findings of present study, a significant reduction in blood Ca and P levels at 1 week post-partum was observed in Ouled Djellal ewes (Berkani *et al.* 2018). A decrease of Ca levels in lactating cow was reported by Ivanov *et al.* (1990); Fikadu *et al.* (2016) and in lactating goat was indicated by Krajnicakova *et al.* (2003) and observed that this decrease was in relation with the passage of Ca to the milk during lactation that leads to a several adaptation in the metabolism of this ion. Furcht (1988) reported that the decrease in inorganic phosphorus, may be due to very low phosphorus content in the diet (animal beet leaves, silage), or components with a low portion of phosphorus that is not readily available (cereals), or a too low level of animal proteins and/or inadequate mineral supplementation. The high levels of calcium also restrict phosphorus availability and therefore necessarily lead to a too low blood phosphorus level (Zvorc *et al.* 2006).

Na and K levels remain unchanged during all the physiological status. Sodium is the major extracellular cation and is responsible for most of the osmotic force that maintains the size of the extracellular fluid (ECF) compartment. Chloride is the major anion in ECF (Russell and Roussel, 2007). In our study, changes in serum chloride tend to parallel those of sodium which is attributed to the fact that the renal reabsorption of sodium is accompanied by reabsorption of chloride (Russell and Roussel, 2007).

## CONCLUSION

Body condition and haemato-biochemical parameters are used as biological markers to assess the health status of the animals. However, these parameters are affected by various stress conditions like changes in climate, physiological status, feed intake *etc.*, The variation in body condition and haemato-biochemical parameters of Tellicherry does during different physiological status was studied. Physiological status had profound impact on the metabolic profile of does. Marked elevation in Hb, PCV associated with higher oxygen demand and sharp decline of Hb, PCV during lactation associated with elevated erythrocyte devastation in mammary cells were observed. Elevated levels of WBC associated with pregnancy and lactation stress was evident during the study. An elevated LDH and TP level associated with initiation of lactation prepartum was recorded. Further, elevated levels of LDH, BUN and TP in relation to negative energy balance and catabolism of protein for milk synthesis was also observed. Reduction in glucose and triglyceride levels associated with uptake of glucose for lactose synthesis and triglyceride for milk fat synthesis during lactation period was recorded. Reduction in serum Ca and P levels associated with mobilization of these elements for milk production was evident during the study. However, all these changes were within the reference ranges for goats except for LDH and Ca. To conclude, the late pregnancy and the lactation are the two most important physiological statuses that alter the hemato-biochemical profile of the does to a greater extent.

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