The Pharma Innovation Journal 2022; SP-11(10): 1263-1271

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; SP-11(10): 1263-1271

www.thepharmajournal.com
Received: 08-08-2022
Accepted: 14-09-2022

Devanand Uttamrao Mane
Ph.D. Scholar, Department of Livestock Production Management, College of Veterinary Science, Rajendranagar, Hyderabad, Telangana, India

Kishan Kumar M
Professor and University Head, Department of Livestock Production Management, College of Veterinary Science, Rajendranagar, Hyderabad, Telangana, India

Sarat Chandra A
Professor and Associate Dean, College of Dairy Technology, Kamareddy, Telangana, India

Nagalakshmi D
Professor and Associate Dean, College of Fisheries Science, Pebbair, Telangana, India

Sakaram D
Professor and Head, Department of Animal Genetics Breeding, College of Veterinary Science, Hyderabad, Telangana, India

Venkataramana K
Professor, Department of Veterinary Gynaecology Obstetrics, College of Veterinary Science, Hyderabad, Telangana, India

Suresh Rathod
Professor and Department of Livestock Production Management, College of Veterinary Science, Hyderabad, Telangana, India

Corresponding Author:
Devanand Uttamrao Mane
Ph.D. Scholar, Department of Livestock Production Management, College of Veterinary Science, Rajendranagar, Hyderabad, Telangana, India

Physiological, haematological and serum biochemical parameters of Mahabubnagar local goats under different systems of rearing

Devanand Uttamrao Mane, Kishan Kumar M, Sarat Chandra A, Nagalakshmi D, Sakaram D, Venkataramana K and Suresh Rathod

Abstract
The study was conducted at goat unit, LRS, Mahabubnagar. The mean Hb and PCV of does in G1 group was significantly higher (p<0.01) followed by G2 and G3 groups during lactation and dry period. Mean WBC count of does during pregnancy, lactation and dry period in G1 group was significantly (p<0.01) lower than G2 and G3 groups. The mean RBC count in the three groups during pregnancy was higher than lactation and dry period. The serum total protein, albumin and globulin of does at the starting of the study had non-significant (p<0.05) difference observed between the three groups. During summer, the body temperature of goats at morning hours in the G3 group had significance (p<0.05) difference with G1 group. The respiratory rate during evening hours in the goats had significant (p<0.01) difference between the G1 and G3 group. In summer season, the pulse rate of goats had significant (p<0.05) difference between G1 and G3 group.

Keywords: Goats, Mahabubnagar, different systems, rearing

1. Introduction
Goat farmers mostly rear the animals on community lands without any supplementation (Girish *et al*., 2012) [18]. Three types of system for small ruminants are generally practiced in the country extensive (free range), intensive (stall feeding), and semi-intensive grazing with supplementation, (Mohini *et al*., 2018) [31]. On the other hands, population of goats and sheep are increasing rapidly to meet the demand of meat, it is causing overcrowding of available grazing lands and sharp deterioration of grazing resources (Devi *et al*., 2020) [16]. In the coming years, goat rearing under the intensive and semi-intensive system would gain prominence and the traditional extensive system would decrease because of continuous shrinkage in common grazing resources. Possible alternative system of small ruminants rearing for meat purpose can be stall-fed system on a commercial scale in areas where pasture lands are shrinking (Kumar and Pant, 2003) [25]. The blood system is sensitive to temperature changes and is an important indicator of physiological responses to stressors (Ribeiro *et al.*, 2018) [39]. Hematological and biochemical profiles are important to be determined because they provide valuable information about the animals health status (Madan *et al.*, 2016) [27]. The physiological adaptation were widely determined using the hematological values (Shah *et al.*, 2007) [42]. Hence, the present study was planned to study the physiological and blood biochemical parameters of Mahabubnagar local goats under different systems of rearing.

2. Materials and Methods
The present study was undertaken at Livestock Research Station, Mahabubnagar district, situated between $77^0$15' and 79^0 15'E, of eastern longitudes and $15^0$55' and 17^0 20N, of northern latitudes. For the study sixty Mahabubnagar local goats of above one year age were selected in a Complete Randomized Design (CRD). These sixty does were assigned to each of the rearing systems (3x20) *viz*., Intensive group (G1), Semi-intensive group (G2), and Extensive group (G3).

2.1 Physiological data recording
Physiological responses of Mahabubnagar local goats were recorded twice a day at 7.30 to 8.30 AM and 4.30 to 5.30 PM at monthly intervals.

2.1.1 Rectal Temperature (RT)
The rectal temperature was recorded accurately by using clinical thermometer, its inserted into rectum, ensuring that the thermometer bulb was left in contact with the rectal mucosa for 1.5-2.0 minutes. The observations were recorded in degree Fahrenheit (ºF).

2.1.2 Respiration Rate (RR)
The respiration rate was recorded by observing flank movement for one minute in which each inward and outward movement of the flank was counted as one complete respiration. The respiration rate was expressed as breaths per minute (bpm).

2.1.3 Pulse Rate
The pulse rate of the animals was recorded by observing the pulsation of femoral artery on the inner surface of the upper part of thigh with the help of finger. The pulse rate was recorded per minute.

2.2 Blood collection for haematology
The whole blood sample 2 ml was collected by using clean, dry, sterilized vacutainer tube of 3 ml capacity containing K3 ethylene diamine tetra acetic acid (EDTA) as anticoagulant. The vacutainer tube was kept in cool ice pack immediately after collection maintaining temperature at 5 °C. The various haematological parameters *viz*. haemoglobin, packed cell volume, total erythrocyte count, total leukocyte count, were estimated by hemo auto-analyzer within 24 hrs.

2.3 Serum collection for biochemical studies
For collection of serum, the blood 5 ml was collected by using dry, clean and sterilized vacutainer tube plain containing clot activator. The vacutainer tubes kept in slant position for 2 hours without disturbance and serum were collected into 1ml tarson micro centrifuge tubes. The serum samples were centrifuged in cool centrifuge at 3000 rpm for 5 minutes and then transferred into new tarson micro centrifuge tubes and stored at -20 °C until the analysis.

(Estimation of serum biochemical parameters)
Biochemical parameters like total protein, albumin, globulin and cholesterol in does were analysed in serum samples collected before breeding season, during late pregnancy and first week of lactation.

2.3.1 Serum Total Protein
The total protein was estimated in the serum by using Biuret method (commercial kit, Coral Clinical Systems, Goa) spectrophotometer.

Total proteins (g/dl) = [Absorbance of Test / Absorbance of standard × 8]

2.3.2 Serum Albumin
Bromocresol green (BCG) method was used to estimate albumin content of serum by spectrophotometer (Spectro UV-VIS Double Beam, UVD-3000) using a commercial kit supplied by Coral Clinical Systems, Goa.

Albumin (g/dl) = [Absorbance of Test /Absorbance of standard× 4]

2.3.3 Serum Globulin
Globulin concentration in the serum was calculated by subtracting the albumin from total protein.

Globulin (g/dl) = [Total proteins (g/dl) - Albumin (g/dl)]

2.3.4 Serum Cholesterol
The cholesterol content in serum was estimated by using a commercial kit (Coral Clinical Systems, Goa) in spectrophotometer (Spectro UV-VIS Double Beam, UVD-3000).

Cholesterol (mg/dl) = [Absorbance of Test Absorbance of standard × 200]

2.4 Statistical analysis
The data were subjected to analysis of variance (Snedecor and Cochran, 1989). Correlations between body weight and body measurements were studied using Pearson's formula. The comparison of means of different subgroups was made by Duncan's multiple comparison post hoc tests as using SPSS 25 statistical software. The level of significance was determined at $p<0.05$ described by Kumar (1957).

3. Results and Discussion
3.1 Physiological parameters of does
3.1.1 Temperature
The monthly body temperature (ºF) during morning and evening of Mahabubnagar local does in different systems of rearing is presented in Table 4.26 and Fig 4.22. The mean body temperature of (ºF) does in the morning hours was between 100.85 and 102.80, respectively. The mean body temperature (oF) of does during the morning hours was recorded in G1, G2 and G3 groups in the month of August was 100.85±0.21, 100.90±0.14 and 101.45±0.11 respectively. The corresponding values were102.05±0.0, 102.20±0.14 and 102.80±0.17in the month of March. The mean body temperature in the morning hours of G1 group was non significantly ($p<0.05$) differ with G2 and G3 groups in the months June to January expect September and December, while G1 group in February, March had non-significant with G2 and significant ($p<0.05$) with G3 while in April and May month G1 group significant ($p<0.05$) difference observed with G2 and G3 groups.
The mean body temperature in the morning hours of G2 group had non significance difference with G3 group during the stu dy period, except in the months of February and March, whereas it was significant to the G1 group for the months of September, December, April and May. The mean body temperature in the morning hours of G3 group were non-significant to G1 and G2 groups in months of June to January and significant ($P<0.05$) in the months of September and December. Similarly G3 group was nonsignificant ($p<0.05$) to G2 group in the months of September, December, April and May while significant ($p<0.05$) to G1 group in the month of September and December during the study period.
In the evening hours, the mean body temperature (ºF) of the does were higher than the morning body temperature in all the three groups during the study period. The mean body temperature (ºF) of does in the evening hours of April month was 103.00±018, 103.65±0.11, and 104.05±0.17, respectively in G1, G2 and G3 group, which was higher during the study

period. Statistical analysis of the data revealed that G1 group had significant (p<0.05) difference with G2 and G3 group except June month whereas non - significant (p<0.05) difference was observed among the G2 and G3 group during the entire study period.

Goat like other homeothermic animals maintains their core body temperature within a narrow range best suited to perform normal body functions. Animals can maintain relatively constant body temperature under various environmental conditions with minimal additional energy expenditure to support optimum performance. Small ruminants show a wide variety of adaptive responses in tropical regions to mitigate the direct and indirect effects of heat stress. Sometimes high ambient temperature initiates strong thermoregulatory responses throughout the summer, allowing the extra heat to be dissipated. Some of the commonly seen reactions in small ruminants involve adapted behaviors and physiological and biochemical processes to mitigate the adverse effects of heat and thus preserve thermal equilibrium (Sejian *et al.*, 2012) [41]. The observed body temperature of the goats in the evening hours was higher than in the morning hours in all the groups throughout the year. In summer, the body temperature of the goats during morning hours in the G3 group had a significant (p<0.05) difference from the G1 group. This indicates a higher level of stress in the extensively reared animals during the summer season. An adaptive mechanism to prevent death from heatstroke is the adjustment of rectal temperature by the heat-stressed goat. The rise in body temperature leads to a marked decline in feed intake, thus redistributing the blood flow and changing the endocrine functions that will negatively affect the performance of both production and reproduction (Al-Dawood *et. al.*, 2017) [4].

Similar findings to the present studies for rectal temperature were reported by Chowdhury *et al*. (2002) [15], Banerjee *et al*. (2015) [10] and Bansode *et al*. (2017) [11]. A lower finding in rectal temperature was found by Adedeji (2011) [2] in extensively reared West African Dwarf goats. However a higher rectal temperature was observed by Attia (2016) [7], further, Bello *et al*. (2016) [12] reported that in West African Dwarf goats the evening values were significantly (P<0.05) higher than those of the morning. Sahoo *et al*. (2018) [40] found that the rectal temperature was higher in Ganjam goats than in Black Bengal, Ganjam, and Koraput (Raighar) goats in different agroclimatic zones. While Alyamani (2020) [5] reported that the body temperature was significantly (p<0.05) higher when compared to winter in Sannen goats. No significant differences were reported by Panda *et al*. (2016) [35] in Osmanabadi kids. Normal rectal temperature findings reported by Kumara *et al*. (2017) [26] in Barbari, Jhakrana, and Sirohi goats possessed better adaptability in semi-arid climatic conditions and Bharti *et al*. (2018) [13].

Rectal temperature of the different breeds appeared to be a stable characteristic that did not change with the breed of goat (Thakare *et al.* 2019) [43], hence the selection of goats with high tolerance to thermal stress is primarily important as a basis for future development of goat industry in a hot climate.

3.1.2 Respiratory Rate

The monthly respiratory rate (Breaths/minute) during morning and evening in Mahabubnagar local does in different systems of rearing is presented in Table 4.27 and Fig 4.23. The mean respiratory rate (breaths/minute) of does in the morning hours during the month of June was observed as 26.40±0.61, 28.20±0.41,and 29.60±0.63, respectively in the G1, G2, and G3 groups. The mean respiratory rate of does (Breaths/minute) was higher in the month of April, which was noticed as 33.55±0.44, 35.40±0.46, and 39.00±0.45 in the respected groups. In the month of December, it was observed that 24.90±0.37, 24.10±0.40and 25.10±0.47, respectively in G1, G2 and G3 during morning hours. The mean respiratory rate (Breaths/minute) of G1group does in the morning hours had significant (p<0.05) difference with G2 and G3 groups throughout the study period, but G2 group was non-significant with G1group in the month of August, September, December, February and May, whereas significant (p<0.05) difference was observed in the months of January, March, April, June, July, October and November. The mean respiratory rate (Breaths/minute) of G3 group does had significant (p<0.05) difference in the month of October, November, January, March, and April with G2 and G1 groupwhileG3group was non- significant (p<0.05) with G1 and G2 in the month of August, September, December. The observed mean respiratory rate (breaths/minute) of does during the evening hours in the months July and April were 35.80±0.48, 43.40±0.44,and 43.00±0.42; 42.55±0.45, 48.50±0.38, and 52.80±0.30, respectively in G1, G2 and, G3 groups. The statistical analysis of the mean respiratory rate (breaths/minute) of G1group goat found significant (P<0.05) difference with G2 and G3 group during study period whereas G2 group had significant (P<0.05) difference withG3 group in the months of October and January to May and showed non-significant (p<0.05) difference in the remaining month.

The respiratory rate in the goats during the morning hours was lower than in the evening hours throughout the study period. In winter, the respiratory rate during morning hours had a non significant difference among the three groups. The respiratory rate during evening hours in the goat had a significant (p<0.05) difference between the G1 and G3 groups in the winter, rainy, and summer seasons of the year. Higher respiratory rate in an extensive system of rearing might be due to exposure to higher environmental temperatures which the body reacts to dissipate the heat.

Goats are sensitive to environmental stress and activate peripheral thermal receptors to transmit suppressive nerve impulses to the hypothalamus appetite center, resulting in lower feed consumption, feed conversion ratio, and decreased performance in an extensive system of farming. The respiratory rate observed in the present study was within the range of normal healthy animals. The findings are in agreement with Sejian *et al.* (2010) [41], Banerjee *et al.* (2015) [10], Bello *et al.* (2016) [12], Bansode *et al.* (2017) [11], Kumara *et al.* (2017) [26], Bharti *et al.* (2018) [13], Sahoo *et al.* (2018) [40] and Thakare *et al.* (2019) [43].

Whereas higher respiration rates were reported by Chowdhury *et al.* (2002) [15], Panda *et al.* (2016) [35], and Alyamani (2020) [5], while lower respiratory rates were reported by Adedeji (2011) [2].

The respiration rate, although a less stable attribute, appeared to indicate more accurately a differential level of adaptability among the various breeds, supporting the fact that of all the physiological reactions, the respiration rate is the most sensitive index for determining the heat tolerance capacity of goats. Mahabubnagar local goats appear to stand the variation in climatic elements by adjusting vital physiological reactions during different seasons of the year.

3.1.3 Pulse Rate

The pulse rate (beats/minute) during morning and evening of Mahabubnagar local does in different systems of rearing is presented in Table 4.28 and Fig 4.24. The mean morning pulse rate (beats/minute) of the goat recorded was 62.8±0.34, 67.3±0.49, and 66.1±0.61; 75.6±0.40, 77.2±0.53 and 80.4±0.69, respectively in G1, G2, and G3 groups in October and April. The mean morning pulse rate (Beats/minute) of G1 group had significant (p<0.05) difference with G2 and G3groups during study period. The mean pulse rate(beats/minute) of does during morning hours in G2 and G3 groups in the months of March, April and May was significantly (p<0.05) differ, while from June to February had non-significant (p<0.05) difference.

The mean evening pulse rate (Beats/minute) of does was higher in G1 (85.1±0.47), G2 (91.1±0.61), and G3 (100±0.65) groups in the month of April of the year. In November, the mean pulse rate (Beats/minute) of does in the evening was 78.2±0.65, 81.5±0.46and 89.5±0.58, respectively in G1, G2, and G3 groups which was lower in the year. The mean evening pulse rate (Beats/minute) of does in the G1 group had significant (p<0.05) difference with G2 and G3 group throughout the study period, whileG2 group significantly (p<0.05) differ from G3 group in all the months of the year expect in the month of June.

The pulse rate primarily represents the homeostasis of blood, along with metabolic conditions in general. The observed pulse rate of the goats during morning hours in the winter season had a non significant difference between the three rearing systems. In the summer season, the pulse rate of goats had a significant (P<0.05) difference between the G1 and G3 groups during the morning and evening hours. The higher pulse rate might be a result of a higher heart beat and metabolic rate due to grazing for long distances. The increased pulse rate will increase the blood flow beneath the body surface, thereby dissipating more heat from the skin through conduction, convection, radiation, and water diffusion (Adedeji, 2011) [2].

Higher pulse rates in present studies were reported by Banerjee *et al.* (2015) [10], Attia (2016) [7], Bello *et al.* (2016) [12], Panda *et al.* (2016) [35], and Bansode *et al.* (2017) [11]. Similar findings to the present study were recorded by Thakare *et al.* (2017) [44], Kochewad *et al.* (2017) [24] and Bharti *et al.* (2018) [13].

2. Materials and Methods

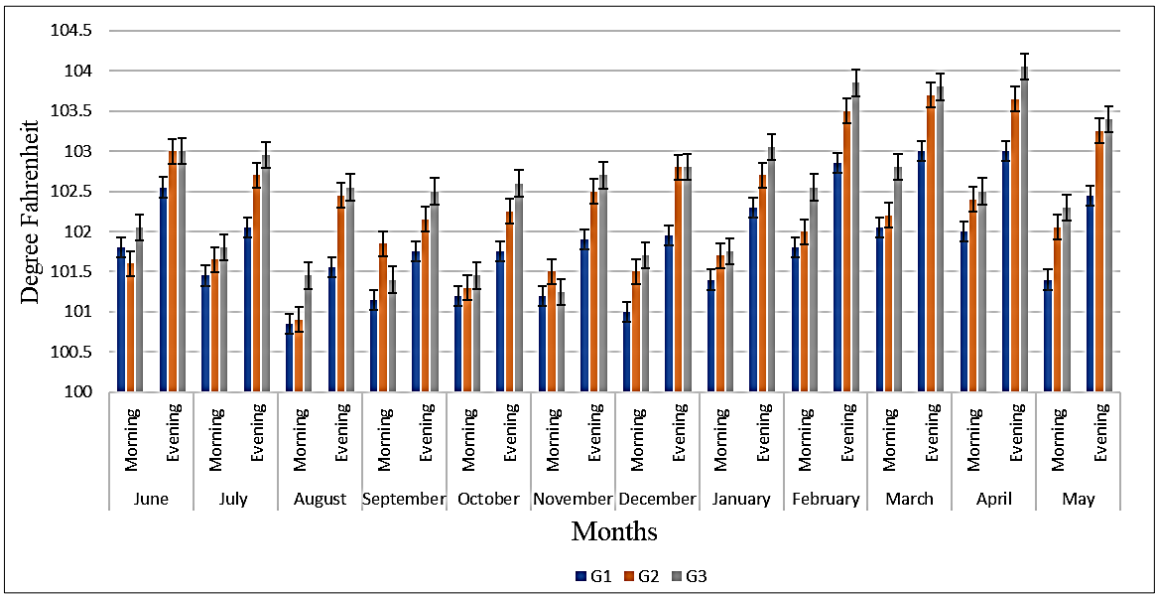

Fig 1: Body temperature (°F) of Mahabubnagar local does in different systems of rearing

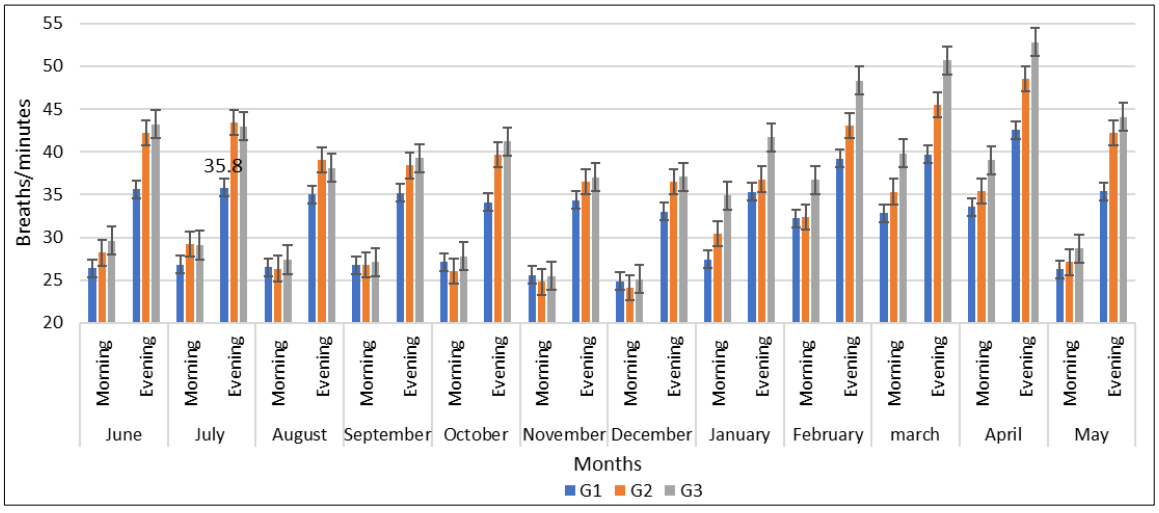

Fig 2: Respiratory rate (Breaths/minute) of Mahabubnagar local does in different systems of rearing

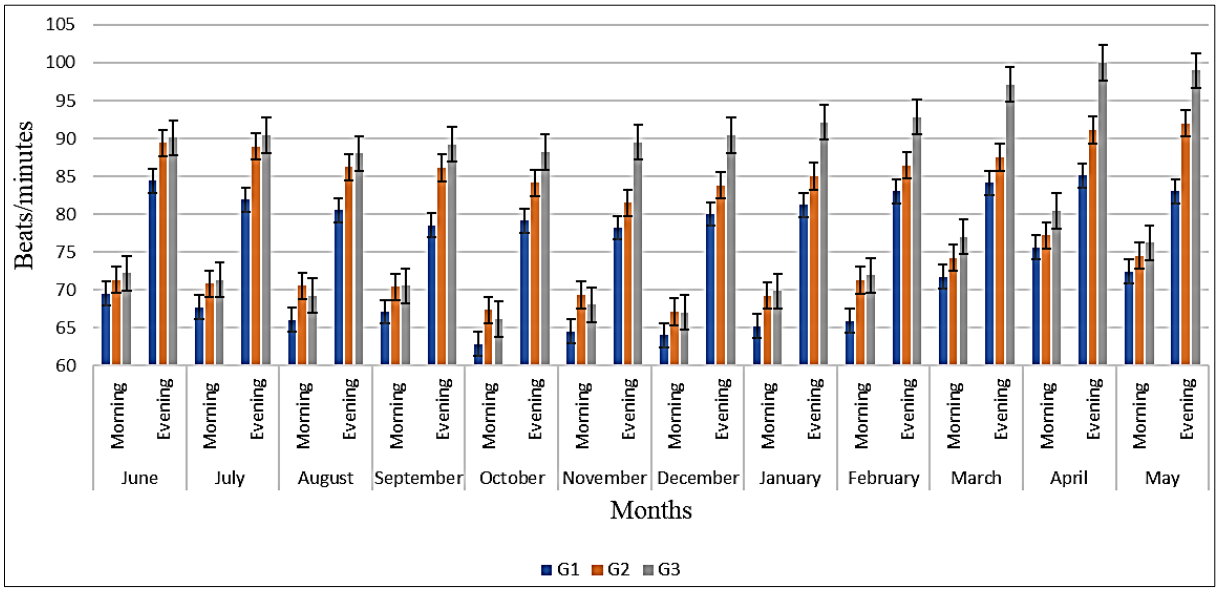

Fig 3: Pulse rate (Beats/minute) of Mahabubnagar local does in different systems of rearing

3.2 Haematology of goats in different systems of rearing

The haematology of does in different systems of rearing at different physiological stages are presented in Fig 4, 5 and 6 respectively.

3.2.1 White Blood Cells (WBC) (10^3/µl)

The mean WBC (103/µl) count during starting of the study in the does was 11.10±0.13, 11.86±0.10,and 11.77±0.22, respectively in the G1, G2 and G3 groups and had non-significant (p<0.05) effect among the three groups. The mean WBC (103 /µl) count in does during pregnancy was 10.68±0.18, 12.52±0.17,and 13.24±0.22, respectively and significant (p<0.05) difference was observed among G1, G2 and G3 groups.

The mean WBC (103/µl) count during the lactation period in does was significantly (P<0.05) higher in G3 (14.05±0.23) than G2 (11.91±0.15) and G1 (10.89±0.15) groups, similarly G1, G2 and G3 groups had significant (P<0.05) difference (P<0.05) among the groups. The mean WBC (103/µl) count of the does during the dry period in G1, G2 and G3 groups were 10.68±0.16, 11.83±0.20 and 13.61±0.34, respectively.

The hematological values recorded in the present study were within the normal range. The mean WBC (103/µl) count of does in the G1 group was lower than G2 and G3 groups and had a significant (p<0.05) effect in all the physiological conditions in the present study except at the starting of the study. In the semi-intensive and extensive systems of rearing, the animals are more exposed to pathogens and environmental stress factors than intensive rearing and higher WBC counts are found in the former rearing systems to combat these threatening circumstances. Further blood parameters of animals differed due to several factors such as breed, age, sex, health status, altitude, management, feeding level, hematological techniques used, seasonal variation, temperature, and physiological status of the animal (Mbassa and Poulsen, 2003) [29].

Similar results were reported by Gupta *et al*. (2008) [19], and higher findings to the present studies were reported by Patil *et al*. (2014) [36], Mohammed *et al*. (2016) [30], and Nur El Huda *et al*. (2016) [34]. These findings also coincided with Banerjee *et al*. (2015) [10], however, Attia (2016) [7], and Al-Bulushi *et al*. (2017) [3] reported that insignificant change in white blood cell count, and Babale *et al*. (2019) [8] reported normal values in West African Dwarf goats.

3.2.2 Red Blood Cells (RBC) (10^6/µl)

The mean RBC (106/µl) count during commencement of study in the group G1, G2, and G3 was 10.08±0.23, 10.12±0.24 and 10.31±0.14, respectively and had non-significant (p<0.05) difference between the groups. The mean RBC (106/µl) count in pregnant does was significantly (p<0.05) higher in G1 (13.00±0.20) group than G2 (10.88±0.12) and G3 (10.08±0.11) group, however G2 group non significantly (p<0.05) differ with G3 group.

In the lactating does, the mean RBC (106/µl) count was 11.86±0.15, 10.02±0.13and 9.76±0.10 in G1, G2 and G3 groups, respectively. The mean RBC (106/µl) count of G1 group was significantly (p<0.05) differ with G2 and G3 group whereas non- significant (p<0.05) difference was observed between G2 and G3 group. The mean RBC (106/µl) count was 12.05±0.16, 9.87±0.13 and 9.51±0.13 inG1,G2, and G3 groups, respectively in dry does and G1 group significantly (p<0.05) differ with G2 and G3, whereas G2 and G3 groups were non- significant.

In the present study, the mean RBC (106/µl) of does was higher in G1 than G2 and G3 groups during pregnancy, lactation, and dry period. Similar findings were reported by Patil *et al*. (2014) [36], and Bansode *et al*. (2017) [11] on Osmanabadi goats. Red blood cell counts were significantly higher compared to the present studies as reported by Njidda *et al*. (2013) [33], Banerjee *et al*. (2015) [10], Manat et. al. (2016) [28], and Mohammed *et al*. (2016) [30].

3.2.3 Haemoglobin (g/dl)

During starting of the study, the mean haemoglobin (g/dl) was in the range of 8.33-8.69 in all the three groups and there was no significant difference was observed among the groups. The mean haemoglobin (g/dl) in pregnant does of G1, G2, and G3 groups were 11.50±0.11, 9.15±0.12, and 8.34±0.11, respe ctively and significant (p<0.05) effect was found among the three groups during the study period.

The observed mean haemoglobin during lactation period (g/dl) was 9.24±0.13, 8.21±0.07 and 7.34±0.14, respectively in the G1, G2, and G3 groups and G1 group was significantly differ (p<0.05) with G2, G3 groups. The mean haemoglobin (g/dl) in G1, G2, and G3 groups was observed as 9.70±0.14,

8.47±0.09, and 7.82±0.18, respectively in dry does and significant (p<0.05) effect was noticed between the three groups. The haemoglobin (g/dl) content during dry period was significantly (p<0.05) differ among G1, G2, and G3 groups.
The haemoglobin (g/dl) concentration during pregnancy was higher than during lactation and non-lactation periods in all the three groups. The results of the present study were in agreement with the findings of Njidda *et al.* (2013) [33], Patil *et al.* (2014) [36], Attia (2016) [7], Manat *et al.* (2016) [28], and Mohammed *et al.* (2016) [30]. The haemoglobin (g/dl) concentration of does in the G1 group at different physiological stages was significantly (p<0.05) higher than G2 and G3 groups. This might be due to heat stress in the extensive system, leading to denaturation and precipitation of haemoglobin molecules in the erythrocytes, leading to decreased concentration of haemoglobin in the blood. Haemoglobin values were significantly (p<0.05) influenced by different management systems (Imasuen 2012) [21].

3.2.4 Packed Cell Volume (PCV) (%)
The mean PCV (%) values of all three groups during the commencement of the study were between 30.27±2.27 to 31.85±0.16 and had no significant (P<0.05) difference among the groups. The mean PCV (%) were significantly (p<0.05) higher in G1 group (32.01±0.22) than G2 (30.07±0.26), G3 (29.42±0.18) group during pregnancy and the mean values of the G1 group significant to G2 and G3 group whereas significantly differ with G3 group
The mean PCV (%) values were 33.61±0.27, 31.52±0.26 and 29.09±0.29 during the lactation period in the G1, G2 and G3 group does, respectively, and significant (P<0.05) was observed between the three groups.
The mean PCV (%) value was significantly (P<0.05) higher in G1 (32.26±0.43) and G2 group (31.29±0.34) than G3 (29.67±0.30) group but the G1 and G2 groups were non-significantly (P<0.05) to each other whereas significant difference was observed with G3 group in dry does.
Blood serves as a pathological reflector to the toxicant and other conditions in exposed animals. Animals with good blood composition are likely to show good performance. The PCV (%) in the does was significantly (P<0.05) lower in G3 than in G2 and G1 groups. The results of the present study were contrary to Kochewad (2015) [23] who reported higher PCV (%) values in the extensive system than intensively reared animals, it might be due to hemoconcentration developed by dehydration leading to the release of erythrocytes concentration in the spleen. However, the ample supply of clean drinking water to the grazing goat throughout the study period might have combated the haemoconcentration and altered the results. PCV values were significantly influenced by the management system (Imasuen, 2012) [21]. Patil *et al.* (2014) [36], Njidda *et al.* (2013) [33], and Attia (2016) [7] reported similar findings compared to the present study. While higher PCV values were reported by Banerjee *et al.* (2015) and Babale *et al.* (2019) [8] in West African Dwarf goats.

3.3 Serum biochemical parameters in does
The serum biochemical parameters (cholesterol) of does in different systems of rearing is presented in Fig 7.

3.3.1 Serum total protein (g/dl)
The mean serum total protein (g/dl) of does at the beginning of the study was recorded as 6.20±0.02, 6.25±0.03,and 6.18±0.04, respectively in the G1, G2 and G3 groups and nonsignificant (p<0.05) difference was observed among the groups. The mean total serum protein (g/dl) of does during pregnancy in G1 group (6.52±0.02) group was significantly (p<0.05) higher than G2 (6.00±0.04) and G3 (5.98±0.03) groups, whereas G2 and G3 groups were non-significant. The mean total serum protein (g/dl) of does during lactation in G1 group was significantly (p<0.05) higher than G2 and G3 group but G2 and G3 groups were non-significant (P<0.05). The mean total serum protein (g/dl) of does during the dry period in G3 (5.75±0.03) group was significantly (P<0.05) lower than G1 group (6.71±0.02) whereas G2 and G3 group were non-significant (P<0.05) to each other.
The serum total protein (g/dl) of the G1 group was higher than than G2 and G3 groups during pregnancy, lactation, and dry period. The higher serum total protein in intensive goats is due to the effective conversion of non-protein nitrogen substances into amino acids and protein (Reddy *et al.*, 2019) [38]. The intensively reared goat may have a higher microbial rumen count, which is known to synthesize proteins from the available non-protein source. The serum total protein (g/dl) of does observed in the present study was within the range and supported by the Dutta *et al.* (1996) [17], Gupta *et al.* (2005) [20], and Nayak *et al.* (2013) [32].
In the present study during the dry period, serum total protein increased in the G1 and G2 group over pregnancy due to decreased maternal serum protein concentrations increased fetal growth, and use of the maternal circulation of amino acids for protein synthesis in the fetal muscles (Antunovic *et al.*, 2002) [6]. During lactation, the serum total protein of does in the G1, G2, and G3 groups was slightly higher than during pregnancy due to the high energy needed for milk synthesis in animals. These findingswere supported by Njidda *et al.* (2013) [33], Manat *et al.* (2016) [28], Cepeda-Palacios *et al.* (2018) [14], Bharti *et al.* (2018) [13], Balamurugan *et al.* (2015) [9] and Mohammed *et al.* (2016) [30].

3.3.2 Serum albumin (g/dl)
The mean serum albumin (g/dl) values of does at the commencement of the study in three groups was similar. The mean serum albumin (g/dl) of does during pregnancy in the G1 group was higher than G2 and G3 group and G1 group had significant (P<0.05) difference with G2 and G3 groups, whereas G2 and G3 group were non-significant (P<0.05).
The mean serum albumin (g/dl) of does during lactation period in G3 (3.20±0.02) group was non-significantly (P<0.05) lower than G2 (3.31±0.02) and G1 (3.50±0.03) groups but G1 group significantly differ (P<0.05) with G2 and G3 groups. The mean serum albumin (g/dl) of does during dry period in groups G1, G2and G3 was 3.60±0.0 3, 3.28±0.02and 3.12±0.01, respectively and non significance (P<0.05) difference was observed between G2 and G3 groups while G1 group significantly (P<0.05) differ with G2 and G3 group.
The total protein comprises mainly albumin and globulin and these two together indicate the actual protein status of the animal. Among them, albumin gives a long-term measure of protein status. The serum albumin (g/dl) of does in the G1 significant to G2 and G3, whereas G2 and G3 groups during pregnancy, lactation, and dry period were statistically non significant, similar reports were recorded by Al-Bulushi *et al.* (2017) [3], Imasuen (2012) [21], Mohammed *et al.* (2016) [30] and Manat *et al.* (2016) [28] in Omani goat.
A progressive significant decrease in serum albumin levels

compared to the present study was reported by Abdelatif *et al.* (2009) [1], and Attia (2016) [7] due to heat stress. However, Bharti *et al.* (2018) [13] observed the lower serum albumin in goats and Cepeda-Palacios *et al.* (2018) [14] and Babale *et al.* (2019) [8] reported higher levels of serum albumin.

3.3.3 Serum globulin (g/dl)

The mean serum globulin (g/dl) of does at the start of study had non- significant ($P<0.05$)difference between three groups. The mean serum globulin (g/dl) of does during pregnancy in the G1, G2,and G3 groups was 2.98±0.05, 2.79±0.0, and 2.75±0.04, respectively and a significant ($P<0.05$) difference was observed between G1 with G2 and G3 groups, but non-significant ($P<0.05$) difference was observed among G2 and G3 group. The similar trend was noticed for serum globulin (g/dl) levels of does during lactation period. In respect of dry period, G1 group showed higher values followed by G2 and G3 groups but had no significance ($P<0.05$) difference between G1 and G2 groups while these two group were significantly ($P<0.05$) differ with the G3 group.

Globulins not only enhance the immunological status of the animal but also help in the interpretation of abnormal albumin concentrations (Rameshkumar *et al.*, 2003). The serum globulin (g/dl) levels of does observed in the present study were within range and supported by Karthik (2020).

Further findings were coinciding with the present study as reported by Imasuen (2012) [21], and Manat *et al.* (2016) [28]. The serum globulins level was significantly higher than reported by Abdelatif *et al.* (2009) [1] and Babale *et al.* (2019) [8].

3.3.4 Serum cholesterol (mg/dl)

The mean serum cholesterol (mg/dl) of does in the G1, G2 and G3 group was 81.70±0.25, 82.10±0.30, and 84.30±0.33, respectively and no significance ($P<0.05$) difference was observed between the groups at the starting of the study. The mean serum cholesterol (mg/dl) of does during pregnancy in G1 (101.70±0.33) group was significantly ($P<0.05$) higher followed by G2 (74.85±0.40) and G3 (74.50±0.32) group but G2 and G3 groups were non-significant ($P<0.05$).

The mean serum cholesterol (mg/dl) of does in G3 (77.05±0.39) group was significantly ($P<0.05$) lower than G2 (82.95±0.20) and G1 (106.10±0.31) group during lactation period. The mean serum cholesterol (mg/dl) in does during dry period in G1, G2, and G3 groups were 102.85±0.24, 78.15±0.47 and 75.80±0.50, respectively and group G1 was significantly ($p<0.05$) differ with G2 and G3 group, whereas G2 and G3 groups had non-significance($p<0.05$) difference.

The Serum cholesterol (mg/dl) in the G1 group was significantly ($p<0.05$) higher than G2 and G3 groups in all physiological conditions. The serum cholesterol level decreased during pregnancy than during lactation and dry period in the three groups. It was opined that increased turnover of cholesterol from the plasma pool for the synthesis of progesterone during late pregnancy. The higher serum cholesterol during the lactation period in all the groups indicated that the body fat reserve was mobilized for glucose metabolism especially when glucose levels fall during increased demand for energy during early lactation (Gupta *et al.*, 2005) [20]. The serum cholesterol level in does in the present study was similar and comparable to the findings of Cepeda-Palacios *et al.* (2018) [14]. While lower serum cholesterol levels were reported by Manat *et al.* (2016) [28] and Kiran *et al.* (2012) [22], the lower levels may be due to differences in the physiological and nutritional status of animals.

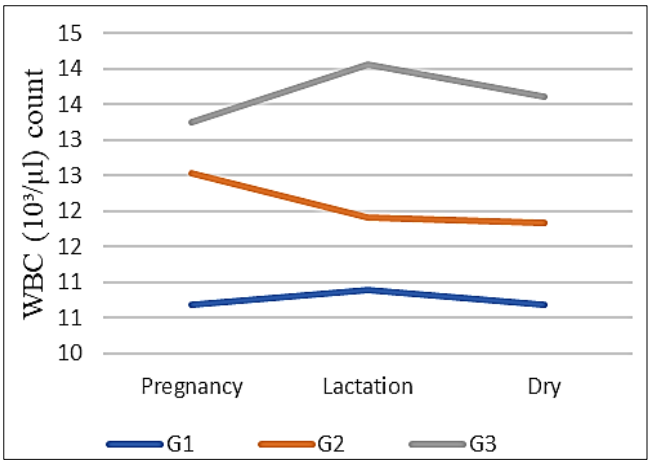

Fig 4: WBC (10^3/µl) count of Mahabubnagar local goat in different systems of rearing

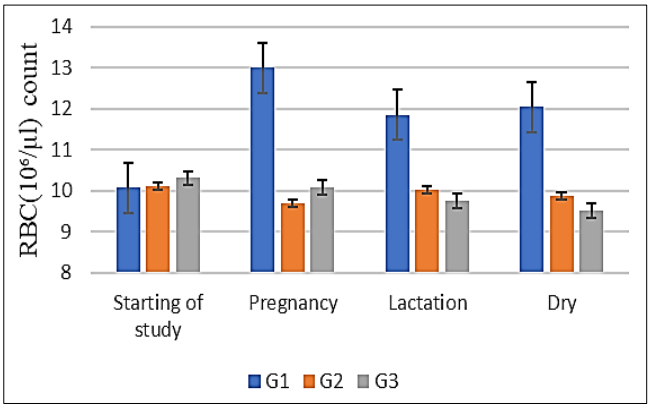

Fig 5: RBC (10^6/µl) count of Mahabubnagar local goat in different systems of rearing

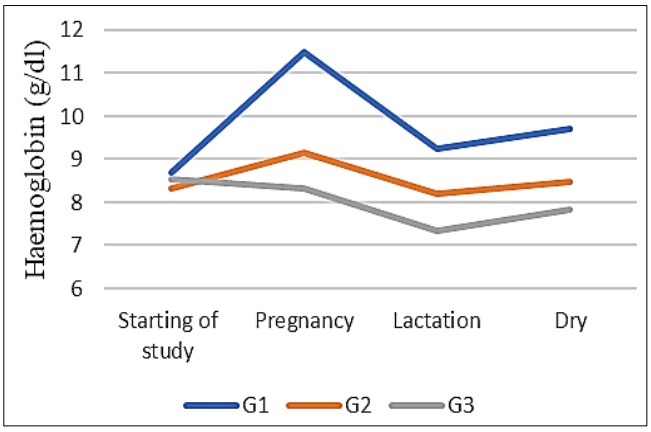

Fig 6: Haemoglobin (g/dl) of Mahabubnagar local goat in different systems of rearing

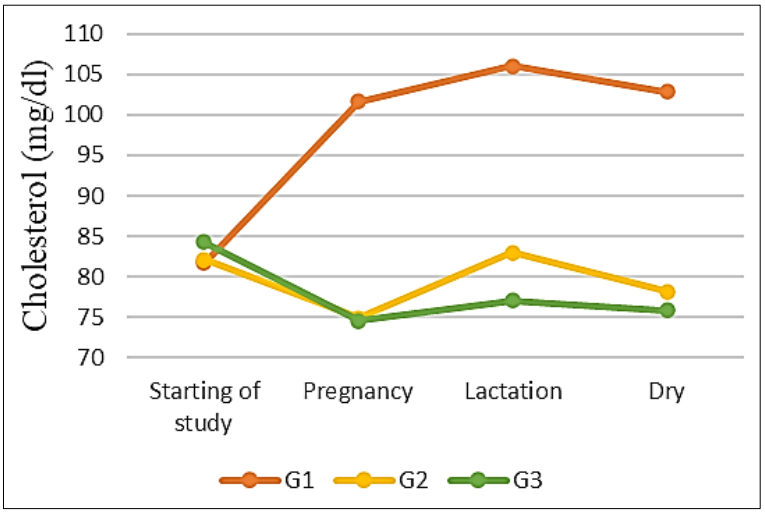

Fig 7: Cholesterol (mg/dl) level of Mahabubnagar local goat in different systems of rearing

4. Conclusion

The physiological parameters under different rearing systems indicated that goats adaptability to heat stress is poor in extensive system and this may impact the productive and reproductive performances. Hematological and serum biochemical parameters under different systems of rearing indicated that intensive system of rearing could be recommended for better growth and overall performances of Mahabubnagar local goats in Telangana, state of India.

6. Acknowledgement

Authors are thankful to the University officers of P. V. Narsimha Rao Telangana Veterinary University, Hyderabad, Telangana, India for according permission to carry out the research work.

7. Declaration of Conflicting Interests

The authors have no conflict of interest to declare.

8. References

1. Abdelatif AM, Ibrahim MY, Hassan YY. Seasonal Variation in Erythrocytic and Leukocytic Indices and Serum Proteins of Female Nubian Goats. Middle-East Journal of Scientific Research. 2009;4(3):168-174.
2. Adedeji TA. Effect of some qualitative traits and non-genetic factors on heat tolerance attributes of extensively reared West African Dwarf (WAD) goats. International Journal of Applied Agricultural and Apicultural Research. 2011;8(1):68-81.
3. Al-Bulushi S, Shawaf T, Al-Hasani A. Some hematological and biochemical parameters of different goat breeds in Sultanate of Oman "A preliminary study". Veterinary world. 2017;10(4):461.
4. Al-Dawood A. Towards heat stress management in small ruminants–a review. Annals of Animal Science. 2017;17(1):59-88.
5. Alyamani D. Impact various seasons on expression patterns HSP60 and physiological parameters. Journal Dairy Veterinary Animal Research. 2020;9(1):1-4.
6. Antunovic Z, Maric I, Klir Z, Seric V, Mioc B, Novoselec J. Haemato-biochemical profile and acid–base status of Croatian spotted goats of different ages. Archivesanimal breeding. 2019;62(2):455-463.
7. Attia NE. Physiological, hematological and biochemical alterations in heat stressed goats. Benha Veterinary Medical Journal 31. 2016;(2):56-62.
8. Babale DM, Millam JJ, Gworgwor Z. Blood profile and carcass characteristics of West African Dwarf goats fed groundnut haulms and cowpea husk supplemented with brewers' dried grain. Biomedical Journal Science and Techological Research. 2019;16(1).
9. Balamurugan R, Durgalakshmi R, Sheeba A. Effect of gender on certain serum biochemical parameters of desi goats in Cauvery Delta region. Journal of Animal Nutrition and Physiology. 2015;1:34-6.
10. Banerjee D, Upadhyay RC, Chaudhary UB, Kumar R, Singh S, Ashutosh, *et al*. Seasonal variations in physio-biochemical profiles of Indian goats in the paradigm of hot and cold climate. Biological Rhythm Research. 2015;46(2):221-36.
11. Bansode Sandip, Amol Salankar, Sandeep Shahapure, UP Mainde, Chaudhari SB. The growth performance of osmanabadi kids under conventional and loose housing. International Journal of Science, Environment and Technology. 2017;6(2):1075-79.
12. Bello SA, Akintunde OG, Sonibare AO, Otesile EB. Effect of sex, age and time of the day on vital parameters of apparently healthy West African Dwarf goats in Abeokuta, Nigeria Alexandria. Journal of Veterinary Sciences. 2016;49(2):8-23.
13. Bharti VK, Kumar P, Biswas A, Kumar K, Gogoi D, Pawar DD, *et al*. Development of region specific hybrid goat and their performance evaluation under high altitude condition. Defence Life Science Journal. 2018;3(2):165-71.
14. Cepeda-Palacios R, Fuente-Gómez MG, Ramirez-Orduna JM, Garcia-Alvarez A, Llinas-Cervantes X, Angulo C. Effects of pregnancy and post-kidding stages on haematochemical parameters in cross-bred goats. Journal of Applied Animal Research. 2018;46(1):269-73.
15. Chowdhury SA, Bhuiyan MS, Faruk S. Rearing Black Bengal goat under semi-intensive management physiological and reproductive performances. Asian Australasian Journal of Animal Sciences. 2002;15(4):477-84.
16. Devi I, Shinde AK, Kumar A, Sahoo A. Stall feeding of sheep and goats: An alternative system to traditional grazing on community lands. Indian Journal of Animal Sciences. 2020;90:318-26.
17. Dutta A, Sarmah S, Rajkhowa NK. Haematological and

biochemical studies in sheep of Assam. Indian Veterinary Journal. 1996;73(4):402-405.
18. Girish PS, Reddy BP, Ramakrishna C, Ramana Reddy Y, Satish Chava and Kondaiah N. Effect of nutrient supplementation on growth performance and carcass characteristics of Nellore ram lambs - An on-farm evaluation study. Indian Journal of Animal Sciences. 2012;82(12):1601-02.
19. Gupta VK, Kumar A, Vihan VS, Sharma SD. Studies on haemogram in sub-clinical ketosis in goats and sheep in organized farming system. Indian Journal of Small Ruminants. 2008;14(1):114-117.
20. Gupta VK, Sharma SD, Vihan VS and Kumar A. Studies on biochemical parameters in different physiological states in sheep under semi intensive system of management. Indian Journal of Small Ruminants. 2005;11(2):161-165.
21. Imasuen JA. Effect of different management environment on hematological perfomance in West African Dwarf (WAD) goats. Journal of Research in Forestry, Wildlife and Environment. 2012;4(2):73-8.
22. Kiran S, Bhutta AM, Khan BA, Durrani S, Ali M, Iqbal F. Effect of age and gender on some blood biochemical parameters of apparently healthy small ruminants from southern Punjab in Pakistan. Asian Pacific Journal of Tropical Biomedicine. 2012;2(4):304-6.
23. Kochewad SA. Productive, reproductive performance and carbon sequestration of Deccani sheep in different farming systems. Thesis submitted to Sri Venkateswara Veterinary University Tirupati; c2015.
24. Kochewad SA, Raghunandan T, Sarjan Rao K, Kondal Reddy K, NaliniKumari, N, Ramana DBV, *et al*. Effect of different farming systems on physiological response, blood parameters and endocrinological profiles in Deccani sheep. Indian Journal of Animal Sciences. 2017;87(7):856-858.
25. Kumar S, Pant KP. Development perspectives of goatrearing in India: Status, issues and strategies. Indian Journal of Agricultural Economics. 2003;58(4):752-6.
26. Kumara D, Yadav B, Choudhuryc S, Kumaria P, Madan AK, Singhd SP, *et al*. Evaluation of adaptability to different seasons in goat breeds of semi-arid region in India through differential expression pattern of heat shock protein genes. Biological Rhythm Research. 2017;49(3):466-78.
27. Madan J, Sindhu S, Gupta M, Kumar S. Hematobiochemical profile and mineral status in growing beetal goat kids. Journal Cell Tissue Research. 2016;16:5517-5522.
28. Manat TD, Chaudhary SS, Singh VK, Patel SB, Puri G. Hematobiochemical profile in Surti goats during post-partum period. Veterinary world. 2016;9(1):19.
29. Mbassa GK, Poulsen JSD. Reference ranges for clinical chemical values in Landrace goats. Small Ruminant Research. 2003;10(2):133-142.
30. Mohammed SA, Razzaque MA, Omar AE, Albert S, Al-Gallaf WM. Biochemical and haematological profile of different breeds of goat maintained under intensive production system. African Journal of Biotechnology. 2016;15(24):1253-7.
31. Mohini M, Malla BA, Mondal G. Small ruminant sector in India: Present status, feeding systems and greenhouse gas emissions. EC Veterinary Science. 2018;3(1):281-89.
32. Nayak S, Mohapatra AK, Barik N, Sahoo GR. Haemato-biochemical studies in ganjam sheep of odisha reared under grazing system. Indian Journal of Small Ruminants (The). 2013;19(1):88-91.
33. Njidda AA, Hassan IT, Olatunji EA. Haematological and biochemical parameters of goats of semi arid environment fed on natural grazing rangeland of Northern Nigeria. IOSR Journal of Agriculture and Veterinary Science. 2013;3(2):01-08.
34. Nur El Huda IO, Al-Busaidi RM, Johnson EH. Effects of Age, Breed and Sex on Haematological Parameters of Growing Omani Goat Breeds. Sultan Qaboos University Journal for Science. 2016;21(2):82-88.
35. Panda R, Ghorpade PP, Chopade SS, Kodape AH, Palampalle HY, Dagli NR. Effect of heat stress on behaviour and physiological parameters of Osmanabadi goats under katcha housing system in Mumbai. Journal Livestock Science. 2016;7:196-9.
36. Patil M, Kumar P, Teggelli RG, Ubhale P. A study on comparison of stall feeding system of goat rearing with grazing system. APCBEE procedia. 2014;8:242-7.
37. Prakash BS, Tandon RN. Note on the effect of late pregnancy and early lactation on blood serum cholesterol and total lipids of Holstein X Tharparkar first lactation cows. Indian Journal of Animal Sciences. 1979;49:308-309.
38. Reddy PRK, Kumar SD, Rao RE, Seshiah VC, Sateesh K, Reddy YPR, *et al*. Assessment of eco-sustainability vis-a-vis zoo-technical attributes of soybean meal (SBM) replacement with varying levels of coated urea in Nellore sheep (Ovis aries). Public Library of Science. 2019;14(8):0220252.
39. Ribeiro MN, Ribeiro NL, Bozzi R, Costa RG. Physiological and biochemical blood variables of goats subjected to heat stress–a review. Journal of Applied Animal Research. 2018;46(1):1036-41.
40. Sahoo SS, Mishra C, Nayak G, Sethy K, Behera K. A comparative study on body morphometric, reproductive and vital parameters among indigenous goat population of Odisha, India. Exploratory Animal and Medical Research. 2018;8(1):69-75.
41. Sejian V, Maurya VP, Naqvi SM, Kumar D, Joshi A. Effect of induced body condition score differences on physiological response, productive and reproductive performance of Malpura ewes kept in a hot, semi-arid environment. Journal of Animal Physiology and Animal Nutrition. 2010;94(2):154-61.
42. Shah K, Khan F, Rizvi M, Sadeeq U. Effect of cypermethrin on clinico-haematological parameters in rabbits. Pakistan Veterinary Journal. 2007;27:171-175.
43. Thakare PD, Sawarkar AR, Pawshe MD. Heat tolerance ability in local, Osmanabadi, Barbari, Jamnapari and Sirohi goat with related to rectal temperature. The Pharma Innovation Journal. 2019;8(6):604-605.
44. Thakare PD, Sirothia AR, Sawarkar AR. Heat tolerance ability and its variability in different breeds of goat with reference to pulse rate. International Journal Current Innovation Research. 2017;3(9):805-6.