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Blood biochemical parameters of Sirohi goats reared on grazing versus stall feeding system in Vindhya plateau region of central India

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Abstract
The current experiment was carried out at Livestock Farm Complex (LFC), College of Veterinary Science & Animal Husbandry, Rewa (M.P.) to study the effect of rearing system i.e. Grazing Versus Stall Feeding System on Blood Biochemical profile of Sirohi Goats. Twenty four Sirohi goat kids around 3-4 months age of either sex with uniform body size and weight were selected. They are randomly divided into two groups (group 01 and group 02) of equal number (12 each). Deworming and vaccination carried out routinely as per schedule. Pre adoption period of 15 days was given to all kids before starting research work. The kids were selected for the experiment was free from physiological, anatomical and infectious diseases. Group 01 allowed to rear on complete stall feeding with supplementation of commercial concentrate ration while Group 02 allowed browsing around farm premises. Kids were allowed to feed 2% commercial readymade concentrate feed procured containing (20% protein and ME 2240 kcal/kg) on Dry matter basis and 2% as greens (daily 6 hours grazing). Blood samples was collected at first day (day 0) and last day (day 365) of experiment to estimate the Total erythrocyte count (RBCs), Total leukocyte count (WBCs), Differential leukocytes counts (DLC), Estimation of Haemoglobin (Hb), Packed cell volume (PCV), Aspartate amino transferase (AST)/ SGOT, Alanine amino transferase (ALT)/ SGPT, Blood glucose, Total Protein, Cholesterol. It was found that the system of rearing i.e. Grazing and Stall feeding didn't affect the blood biochemical (total erythrocyte count (million/mm^3), TLC(thousand/mm^3), Neutrophil (%), Lymphocyte (%), Monocyte (%), Eosinophil (%), Haemoglobin (Hb) (g/dl), PCV Packed cell volume (%), SGOT/AST (U/L), SGPT/ ALT (U/L), Blood glucose (mg/dl), Total protein (g/dl) and Cholesterol (mg/dl) and all these are within normal physiological range.

Keywords: Blood biochemical parameter, grazing, sirohi, stall feeding

Introduction
Goats have been connected with humans since the dawn of agriculture and animal domestication, making them a very significant socio-economic animal that offers a variety of goods and services to man across the world, particularly in developing nations. We now refer to it as an ATM. The modern human race may employ goats in a variety of ways. Each component of its body and every one of its products is significant in its own way (Lata and Mondal, 2021) [14]. In India, goats are among the principal livestock used for the production of meat. Chevon, one of the most popular meats is in high demand domestically. The goat is a creature that adapts to practically any environment easily especially in desert areas (Banerjee, 2004). For 40% of India's rural people who live in poverty, goats are a reliable source of income (Maske and Phule, 2011) [17]. With a holding of 11.6% of the global livestock population, India has one of the largest livestock industries in the world (Islam *et al*., 2016) [10]. The 20th livestock census estimates that there are 535.78 million animals in India (BAHS, 2019) [3], which goats make up 27.78%. There are 861.9 million goats in the globe. In India, there are 148.88 million goats in total. The livestock industry provides 4.11% of GDP, whereas agriculture as a whole accounts for about 25.6% of GDP. The Sirohi goat may be found in Arawali Hills, districts in central and southern Rajasthan, and dry and semi-arid regions. The coat is mostly brown with some pale or dark spots.

There are three main techniques for raising small ruminants: extensive, semi-intensive, and intense. Due to the rangelands' poor production and severe degradation, the animals often have low nutritional levels. A full stall feeding on produced fodders, crop leftovers and concentrates, compound feeds or grazing on established pastures mixed with stall feeding are all examples of intensive systems. Less than 5% of small ruminant production systems use it, and it is man power- and capital-intensive. This system is primarily being driven by improved market access for meat in peri-urban regions (Sahoo *et al*., 2015) [20]. Small ruminants are typically raised on resources from common property, supplemented with top feeds and agricultural by products to suit their needs for feed and fodder, but these resources are depleting daily (Shinde and Sejian, 2013) [21]. Due of increased grazing pressure and stocking density, the fodder supply from these resources is declining. Therefore, stall-fed systems on a commercial scale provide a potential option for raising small ruminants for meat in locations where grazing resources are decreasing (Kumar and Pant, 2003) [13]. Small holder farmers are finding intensive production of small ruminants to be an increasingly appealing venture due to the increasing demand for meat and meat products. A considerable portion of small holders and landless workers in rural regions engage in goat-rearing as a livelihood since it consumes a type of feed that would cause other animals to starve (Singh *et al*., 2000 and FAO, 1991) [22, 7]. The intensive manner of goat husbandry has its own relevance because of deforestation and the lack of grazing pasture. In order to maintain productivity in the future when raising goats or sheep, shepherds will need to find alternate methods. Stall feeding with very less inputs is one such potential strategy (Singh and Kumar, 2007) [25]. Therefore, the current experiment was undertaken to compare the grazing system and stall feeding system in small ruminants i.e. goats.

Materials and Methods

The proposed work was carried out at "Goat Unit" of Livestock Farm Complex (LFC) Department of Livestock Production Management, College of Veterinary Science & Animal Husbandry, Rewa (M.P.) with due care that kids should be well identified by use of Tagging for different groups. Twenty four Sirohi goat kids around 3-4 months age of either sex with uniform body size and weight were selected. They are randomly divided into two groups (01 and 02) of equal number (12 each). Deworming and vaccination carried out routinely as per schedule. Pre adoption period of 15 days was given to all kids before starting research work. The kids were selected for the experiment was free from physiological, anatomical and infectious diseases. Group 01 allowed to rear on complete stall feeding with supplementation of commercial concentrate ration while Group 02 allowed to browsing around farm premises. Kids were allowed to feed 2% commercial readymade concentrate feed procured containing (20% protein and ME 2240 kcal/kg) on Dry matter basis and 2% as greens (daily 6 hours grazing).

Table 1: Feeding management of experimental animals

S. No.	Groups	Number of animals	Feeding pattern	Period
01.	01	12	Stall Feeding @ 4% of Body Weight (Greens -2%) + Concentrate -2% (Dry Matter Basis)	1year
02.	02	12	Browsing	1year

Blood samples was collected at first day (day 0) and last day (day 365) of experiment to estimate the Total erythrocyte count (RBCs) (million/ mm³), Total leukocyte count (WBCs) (Thousand/mm³), Differential leukocytes counts DLC (%), Estimation of Haemoglobin (Hb) (g/dl), Packed cell volume (%), Aspartate amino transferase (AST)/ SGOT (U/L), Alanine amino transferase (ALT)/ SGPT(U/L), Blood glucose (mg/dl), Total Protein (g/dl), Cholesterol (mg/dl).

The data obtained during the experiment were analysed for two way ANOVA using SPSS statistics software version 20 package as method depicted by Snedecor and Cochran (1994).

Results and Discussion

The total erythrocyte count (million/mm^3), TLC (thousand/mm^3), Neutrophil (%), Lymphocyte (%), Monocyte (%), Eosinophil (%), Haemoglobin (Hb) (g/dl), Packed cell volume (PCV) (%), SGOT/AST (U/L), SGPT/ ALT (U/L), Blood glucose (mg/dl), Total protein (g/dl) and Cholesterol (mg/dl) are estimated and are presented in table 02.

The mean value of total erythrocyte count (million/mm^3) in group 01 and group 02 at 0 day was 8.42 ± 0.15 and 10.17 ± 0.20 and at 365 days was 8.16 ± 0.11 and 10.50 ± 0.29, respectively and the differences in the total erythrocyte count was non significant between the groups. In present study, the TEC values ranged of 8.42 to 10.50 (million/m^3) and was within the normal physiological value of 8 to 18 (million/m^3) reported by Kankeo *et al*. (1997) [11] for goats. The result obtained in the present findings is in agreement with Singh *et al*. (2021) [24] who reported the RBC values were within the normal reference range for goats and disagreement with Patil *et al*. (2014) [18] and Raju *et al*. (2015) [19] who reported the animal kept under intensive system were having higher level in RBC count.

The mean value of TLC (WBCs) (thousand/mm^3) in group 01 and group 02 at 0 day was 9.50 ± 0.26 and10.92 ± 0.45 and at 365 days was 9.92 ± 0.28 and 10.33 ± 0.30, respectively and the differences in total leucocytes count was non significant between the groups. In present study, the TLC values ranged of 9.50 to 10.92 (thousand/mm^3) and was within the normal physiological value of 4 to 13 (thousand/mm^3) reported by Kankeo *et al*. (1997) [11] for goats. The outcomes shown in the current research are consistent with Raju *et al*. (2015) [19] and Patil *et al*. (2014) [18] They observed that goats raised in various raising regimens had Total leucocyte counts that were within the normal reference range. as well as opposition to Mane *et al*. (2023) [15] who found a larger increase in TLC count in animals housed in extensive system. Whereas, Attia (2016) [1] discovered a negligible change in the overall leucocyte count. Leucocytes main roles include fighting infections, protecting the body against foreign organism invasion by phagocytosis, and producing or at least transporting and distributing antibodies during an immune response. As a result, animals with low white blood cell counts are more susceptible to infections, whereas those with high counts are able to produce antibodies during the process of phagocytosis and have a high level of disease resistance, which improves adaptability to the environment and the presence of disease (Etim *et al*., 2014) [6].

The mean value of Neutrophil (%) in group 01 and group 02 at 0 day was 35.66 ± 1.04 and 37.50 ± 042 and at 365 days was 33.75 ± 0.92 and 37.66 ± 0.80, respectively. The differences in total neutrophil counts between the groups were

not statistically significant. The neutrophil values in the current study varied from 33.75 to 37.66 (%) and were within the range of 30 to 48 (%) that is considered to be normal physiological range. The findings of the current study are in line with those of Patil *et al*. (2014) [18], who showed that various leucocyte counts upon DLC analysis were in the normal value in the stall-fed group as compared with the grazing group.

The mean value of Lymphocyte (%) in group 01 and group 02 at 0 day was 60.00 ± 1.28 and 57.83 ± 0.68 and at 365 day was 61.25 ± 1.19 and 56.5 ± 0.84, respectively. The differences in total lymphocyte counts between the groups were not statistically significant. The lymphocyte values in the current study varied from 56.50 to 61.25 (%) and were within the range of 50 to 70 (%) that is considered to be normal physiological range. The observations recorded in the present study are similar to the findings of Singh *et al*. (2021) [24]. As they observe no significant difference of lymphocyte and all the values were within the normal reference range of goats. However the present findings are in disagreement with findings of Ghosh *et al*. (2013) [9]. As they reported lymphocyte (%) in males was similar throughout the year but in females it was significantly low during winter season. Lymphocyte (%) shows significant variation among season (P< 0.01) and sexes (P<0.001).

The mean value of Monocyte (%) in group 01 and group 02 at 0 day was 1.42 ± 0.15 and 2.17 ± 0.16 and at 365 day was 1.50 ± 0.15 and 2.58 ± 0.26, respectively. The differences in total monocyte counts between the groups were not statistically significant. The monocyte values in the current study varied from 1.42 to 2.58 (%) and were within the range of 0 to 4 (%) that is considered to be normal physiological range. The result obtained in the present findings are in agreement with Singh *et al*. (2019) [23] who reported non significant difference in monocyte (%) in goats and all the values were within the normal reference range for goats. However the present finding are in disagreement with the observation made by Ghosh *et al*. (2013) [9] who reported monocyte (%) showed decreasing trend in males during monsoon season and winter. But in females the levels was increased in monsoon season and significantly low during winter. The monocyte (%) depicted significant variation in both the sexes (P<0.01).

The mean value of Eosinophil (%) in group 01 and group 02 at 0 day was 1.75 ± 0.25 and 2.50 ± 0.38 and at 365 day was 3.50 ± 0.34 and 3.59 ± 0.39, respectively. The differences in total eosinophil counts between the groups were not statistically significant. The eosinophil values in the current study varied from 1.75 to 3.59 (%) and were within the range of 1 to 8 (%) that is considered to be normal physiological range. The result obtained in the present findings are in disagreement with Ghosh *et al*. (2013) [9] who reported the eosinophil (%) was significantly high during winter season in both males and females. The variations were significantly high between seasons (P<0.001).

The mean value of Haemoglobin (Hb) (g/dl) in group 01 and group 02 at 0 day was 9.45 ± 0.29 and 9.37 ± 0.28 and at 365 day was 9.16 ± 0.29 and 9.57 ± 0.31, respectively. The differences in total haemoglobin (g/dl) between the groups were not statistically significant. The haemoglobin values in the current study varied from 9.16 to 9.57 (g/dl) and were within the range of 8 to 12 (g/dl) that is considered to be normal physiological range. The result obtained in the present findings are in disagreement with Mane *et al*. (2022) [16], Singh *et al*. (2021) [24], who reported the haemoglobin(g/dl) concentration of goat in the stall fed group at different physiological conditions was significantly (P<0.05) higher than semi intensive and extensive groups. This might be due to heat stress in the grazing systems, leading to denaturation and precipitation of haemoglobin molecules in the erythrocyte, leading to decreased concentration of haemoglobin in the blood.

The mean value of packed cell volume (%) in group 01 and group 02 at 0 day was 28.28 ± 0.86 and 28.12 ± 0.84 and at 365 day was 24.47 ± 0.87 and 28.71 ± 0.93, respectively. The differences in total PCV (%) between the groups were not statistically significant. The PCV values in the current study varied from 24.47 to 28.71 (%) and were within the range of 22 to 38 (%) that is considered to be normal physiological range. The result obtained in the present findings are in disagreement with Debbarma *et al*. (2022) [5], Mane *et al*. (2022) [16], Singh *et al*. (2021) [24], who reported the significantly higher (P<0.05) PCV (%) concentration of goat in the stall fedding group compared to grazing group.

Table 2: Effect of grazing and stall feeding on haematological parameters in Sirohi goats

Particular		Group 01	Group 02
TEC (RBC) (million/mm^3)	Day 0	8.42 ± 0.15	10.17 ± 0.20
	Day 365	8.16 ± 0.11	10.50 ± 0.29
TLC (WBCs) (thousand/mm^3)	Day 0	9.50 ± 0.26	10.92 ± 0.45
	Day 365	9.92 ± 0.28	10.33 ± 0.30
Neutrophil (%)	Day 0	35.66 ± 1.04	37.50 ± 042
	Day 365	33.75 ± 0.92	37.66 ± 0.80
Lymphocyte (%)	Day 0	60.00 ± 1.28	57.83 ± 0.68
	Day 365	61.25 ± 1.19	56.5 ± 0.84
Monocyte (%)	Day 0	1.42 ± 0.15	2.17 ± 0.16
	Day 365	1.50 ± 0.15	2.58 ± 0.26
Eosinophil (%)	Day 0	1.75 ± 0.25	2.50 ± 0.38
	Day 365	3.50 ± 0.34	3.59 ± 0.39
Haemoglobin (Hb) (g/dl)	Day 0	9.45 ± 0.29	9.37 ± 0.28
	Day 365	9.16 ± 0.29	9.57 ± 0.31
PCV Packed cell volume (%)	Day 0	28.28 ± 0.86	28.12 ± 0.84
	Day 365	24.47 ± 0.87	28.71 ± 0.93

The mean value of SGOT/AST in group 01 and group 02 at 0 day was 64.83 ± 1.06 and 65.91 ± 0.82 and at 365 day was 69.58 ± 1.43 and 70.17 ± 0.98, respectively. The differences in total SGOT (Unit / l) between the groups were non significant. The values of SGOT obtained in the current study were within the normal range (Kaneko *et al*., 1997) [11]. It

could be concluded from the results under stall feeding and grazing system of goat rearing it does not show any influence on SGOT level of goats.

The mean value of SGPT/ ALT in group 01 and group 02 at 0 day was 9.75 ± 0.50 and 12.08 ± 0.62 and at 365 day was 10.50 ± 0.51 and 11.17 ± 0.55, respectively. The differences in total SGPT (Unit / l) between the groups were not statistically significant. The values of SGPT obtained in the current study lies within the normal range (6-19 unit/l) (Kaneko *et al*., 1997) [11]. It could be concluded from the results under stall feeding and grazing system of goat rearing it does not show any influence on SGPT level of goats.

The mean value of Blood glucose (mg/dl) in group 01 and group 02 at 0 day was 68.80 ± 1.33 and 68.42 ± 1.25 and at 365 day was 67.73 ± 1.31 and 69.33 ± 1.20, respectively. The differences in total blood glucose (mg/dl) between the groups were not statistically significant. The blood glucose values in the current study varied from 67.73 to 69.33 (mg/dl) and were within the range of 50 to 75 (mg/dl) that is considered to be normal physiological range. The result obtained in the present findings are in agreement with Singh *et al*. (2019) [23], Raju *et al*. (2015) [19] who reported the mean value of blood glucose obtained in the present study was within normal physiological value (Kankeo *et al*. 1997) [11]. There was no significant (P>0.05) difference in blood glucose between different groups showed that the diet had no adverse effect on these blood parameters in growing Barbari goats. This may be due to accomplishment of minimum nutritional requirement in all the groups. However, the present findings are in disagreement with the observation made by Ghosh *et al*. (2013) [9], Debbarma *et al*. (2022) [5] who reported significantly (*P*< 0.05) higher blood glucose level in stall fed goup as compared to grazing group.

The mean value of Total protein in group 01 and group 02 at 0 day was 7.12 ± 0.74 and 6.82 ± 0.54 and at 365 day was 6.82 ± 0.16 and 6.81 ± 0.11, respectively. The differences in total protein (g/dl) between the groups were not statistically significant. The total protein values in the current study varied from 6.81 to 7.12 (g/dl) and were within the range of 6 to 7.5 (g/dl) that is considered to be normal physiological range. The result obtained in the present findings are in agreement with Singh *et al*. (2021) [24], Raju *et al*. (2015) [19] who reported the mean value of Total protein (g/dl) obtained in the present study was within normal physiological value (Kankeo *et al*. 1997) [11]. There was non significant (P>0.05) difference in total protein (g/dl) among different groups suggesting that the diet had no adverse effect on blood parameters in goats. This may be due to accomplishment of minimum nutritional requirement in all the groups. However, the present findings are in disagreement with the observation made by Debbarma *et al*. (2022) [5], Mane *et al*. (2023) [15] who reported significantly (*P*< 0.05) higher total protein (g/dl) level in stall fed group as correlate to grazing group. The higher total protein in stall fed system of rearing may be due to increased concentration intake than a semi intensive and extensive system of rearing. Similar results were reported by Bharti *et al*. (2018) [4] who observed a significant (*P*<0.05) difference compared to the different systems.

The mean value of Cholesterol (mg/dl) in group 01 and group 02 at 0 day was 100.73 ± 3.24 and 108.60 ± 3.60 and at 365 day was 97.18 ± 3.41 and 97.85 ± 2.53, respectively. The differences in cholesterol (mg/dl) between the groups were not statistically significant. The cholesterol values in the current study varied from 97.18 to 108.60 (mg/dl) and were within the range of 80 to 130 (mg/dl) that is considered to be normal physiological value. The result obtained in the present findings are in agreement with Singh *et al*. (2021) [24], who reported the mean value of cholesterol (mg/dl) obtained in the present study was within normal physiological value (Kankeo *et al*. 1997) [11]. There was non significant (P>0.05) difference in cholesterol (mg/dl) between different groups suggesting that the diet had no adverse effect on these blood parameters in goats. this may be due to accomplishment of minimum nutritional requirement in all the groups. However, the present findings are in disagreement with the observation made by Debbarma *et al*. (2022) [5], Who reported significant cholesterol level in goat under extensive system of rearing. Similarly Mane *et al*. (2023) [15], Raju *et al*. (2015) [19] reported that cholesterol level in kids of intensive group was significantly (*P*<0.05) higher than semi intensive and extensive groups of goat.

Table 3: Effect of grazing and stall feeding on blood-biochemical parameters in Sirohi goats

Particular		Group 01	Group 02
SGOT/AST (U/L)	Day 0	64.83 ± 1.06	65.91 ± 0.82
	Day 365	69.58 ± 1.43	70.17 ± 0.98
SGPT/ ALT (U/L)	Day 0	9.75 ± 0.50	12.08 ± 0.62
	Day 365	10.50 ± 0.51	11.17 ± 0.55
Blood glucose (mg/dl)	Day 0	68.80 ± 1.33	68.42 ± 1.25
	Day 365	67.73 ± 1.31	69.33 ± 1.20
Total protein (g/dl)	Day 0	7.12 ± 0.74	6.82 ± 0.54
	Day 365	6.82 ± 0.16	6.81 ± 0.11
Cholesterol (mg/dl)	Day 0	100.73 ± 3.24	108.60 ± 3.60
	Day 365	97.18 ± 3.41	97.85 ± 2.53

Conclusion

Present study reveals that the system of rearing i.e. Grazing and Stall feeding didn't affect the blood biochemical (total erythrocyte count (million/mm^3), TLC(thousand/mm^3), Neutrophil (%), Lymphocyte (%), Monocyte (%), Eosinophil (%), Haemoglobin (Hb) (g/dl), PCV Packed cell volume (%), SGOT/AST(U/L), SGPT/ ALT(U/L), Blood glucose (mg/dl), Total protein(g/dl) and Cholesterol (mg/dl) and all these are with in normal physiological range.

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