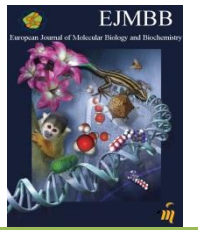
e - ISSN - 2348-2206
Print ISSN - 2348-2192

European Journal of Molecular Biology and Biochemistry

Journal homepage: www.mcmed.us/journal/ejmbb



INTENSIFICATION IN DECCANI SHEEP: HAEMATOLOGICAL AND BIOCHEMICAL INFLUENCES

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Article Info

Received 23/08/2015
Revised 16/09/2015
Accepted 12/10/2015

Key words:- Small ruminants, System of rearing, intensive, Extensive, Mineral, Blood biomolecules.

ABSTRACT

Present investigation has been carried out on eighteen growing lambs (Deccani breed) with an average body weight of 12 to 16 Kg at Livestock Farm, Hayathnagar Research Farm (17°27′N latitude and 78°35′E longitude and about 515 m above sea level), ICAR-Central Research Institute for Dryland Agriculture (ICAR-CRIDA) to investigate the impact of an extensive to intensive production system on blood bio-molecules in Deccani sheep. The animals were divided randomly into three groups (three males and females in each) taking into consideration the group averages of body weights in all 3 groups were as uniform as possible as extensive (without stall supplements), semi-intensive (restricted concentrate offering in stall) and intensive (stall feeding). Animals under experiment were observed regularly for body weight. Blood samples were taken from all animals in early morning. Hematological analysis in terms of red blood cell count (RBC) and white blood cell count (WBC) was performed within 1-2 hours after collection using haemocytometer. Serum was obtained by allowing the blood to clot in room temperature for 2 hours, centrifuged, and collected in a special eppendorf tubes. Serum samples were stored at -20°C until used. Serum was analyzed for total serum protein, albumin, creatinine, glucose, triglycerides, cholesterol, uric acid and urea. Animals kept under intensive system (9.12%) of rearing could achieve superior body weight as compared to extensive (3.87%) and semi-intensive system (6.25%) of rearing. In all production systems, blood haematological and bio-molecular parameters were within the range of physiological limits. The animals kept under intensive system were having higher increase in RBC count, cholesterol and creatinine level with less increase in urea and uric acid levels, thus found to be superior to semi-intensive and extensive system of rearing, where glucose and protein level has increased but urea and uric acid level was severely increased. Thus, it can be suggested that intensive system of rearing is better than other systems in terms of RBC count and blood metabolites.

INTRODUCTION

Over the past decade a progressive decline in the global sheep population was observed, and in 2008 the universal flock size was estimated at 1000 million sheep. This decline could be ascribed to seasonal droughts, unpredictable weather patterns, diminishing land resources and an unstable economy with fluctuating meat prices. The global trend in animal production is a systematic transition from small-scale extensive production to large-scale intensive production systems [1]. This increases the efficiency of livestock production and subsequently productivity and profitability [1,2].

Haematological studies are of ecological and physiological interest in helping to understand the relationship of blood characteristics to the environment

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[3] and so could be useful in the selection of animals that are genetically resistant to certain environmental conditions [4,5]. Blood act as a pathological reflector of the status of exposed animals to toxicant and other conditions [6]. As reported [5], animals with good blood composition are likely to show good performance.

In India, there is scarce work on intensification and its effect on blood biochemistry in sheep. Keeping in view of above points, the present investigation has been carried out to investigate the impact of an extensive (free-range) to intensive (feedlot) production system on blood bio-molecules in Deccani sheep.

METHODOLOGY

Present study was undertaken on eighteen growing lambs (Deccani breed) with an average body weight of 12 to 16 Kg at Livestock Farm, Hayathnagar Research Farm (17°27′N latitude and 78°35′E longitude and about 515 m above sea level), ICAR-Central Research Institute for Dryland Agriculture (CRIDA) to study blood biochemistry of sheep under various managemental conditions. The animals were divided randomly into three groups (three males and females in each) taking into consideration the group averages of body weights in all 3 groups were as uniform as possible. The climate in the region is semi-arid with hot summers and mild winters (mean maximum air temperature during summer 35.6 to 38.6 °C and in winter 13.5 to 16.8 °C with annual long-term rainfall 746.2 mm. Each group of animals was kept in a pen size of 10ft x 10ft on concrete floor with orientation of east-west direction through its long axis. Animals had free access to clean drinking water throughout the day.

Blood samples were taken from all animals in early morning. Five to seven milliliters of whole blood was collected aseptically from the jugular vein using disposable needles and EDTA containing vacutainer tubes and another sample was placed in plain tubes without anti-coagulant. Hematological analysis in terms of red blood cell count (RBC) and white blood cell count (WBC) was performed within 1-2 hours after collection using haemocytometer.

Serum was obtained by allowing the blood to clot in room temperature for 2 hours, centrifuged, and collected in a special epindorf tubes. Serum samples were stored at -20°C until used. Serum was analyzed for total serum protein (Biuret method), albumin (BCG method), creatinine (Kinetic method), glucose (GOD-PAP method), triglycerides (GPO method), and cholesterol (CHOD-POD method). Serum uric acid was determined by an enzymatic method (uricase) using a kit provided by (bioMerieux/ France) [7]. Serum urea was determined by an enzymatic method (urease- modified Berthelot reaction) using kit provided by (bioMerieux/ France) [8].

Results were statistically evaluated using descriptive statistic and significance level was tested using Students ‘t’ test as per [9].

Table 1. Management of protocols was followed for different groups of animals:

System of rearing	B. Wt. (Kg)	Management	Concentrate	Roughage	Dry fodder
Extensive (C)	14.46 ±0.93	Animals were not offered anything in the shed and kept in pen only during night hours	No Concentrate offered	Full grazing (9AM to 12 PM & 2 PM to 5 PM)	1 Kg/day
Semi-intensive (T_1)	14.55 ±1.31	Restricted grazing followed by offering restricted concentrate in the pen	100 gms per day (Restricted)	Restricted grazing (9AM to 11.30AM)	1 Kg/day
Intensive (T_2)	14.37 ±0.96	No grazing, both conc. and roughages were offered in the pen only	150 gms per day (*ad lib*)	No grazing, roughage offered on DM Basis-200gms per sheep in the stall	1 Kg/day

Table 2. Body weight and haematology of sheep in various periods under different system of rearing

Particulars	Extensive System	Semi-intensive system	Intensive system	Overall
Initial B.Wt. (Kg)	14.46	14.55	14.37	14.46
Final B.Wt. (Kg)	15.02	15.46	15.68	15.38
% increase	3.87	6.25	9.12	6.36
RBC Count (million per ml)				
0 day	10.67±0.83	9.48±0.64	7.95±1.02	9.37±0.53
30 days	11.99±0.25	11.88±0.45	12.36±0.22	12.08±0.18
60 days	14.08±0.14	14.62±0.10	14.85±0.12	14.51±0.10
Overall	12.24±0.44^{NS}	11.99±0.56^{NS}	11.72±0.77^{NS}	11.99±0.34
% increase	31.96	54.22	86.79	54.86
WBC Count (‘000 per ml)				
0 day	3.33±0.21	3.38±0.04	3.34±0.06	3.34±0.06

30 days	4.79±0.20	4.36±0.21	4.15±0.14	4.34±0.13
60 days	5.29±0.10	4.62±0.04	4.35±0.06	4.74±0.10
Overall	4.35±0.23 ^{NS}	4.12±0.15 ^{NS}	3.95±0.12 ^{NS}	4.14±0.10
% increase	58.86	36.69	30.24	41.92

^{NS} Non-significant in columns

Table 3. Plasma constituents of sheep blood in various periods under different system of rearing

Blood bio-molecules	Extensive System	Semi-intensive system	Intensive system	Overall
Glucose (mg per 100 ml)				
0 day	41.58±2.65^{a}	41.10±3.73^{a}	49.55±4.93^{b}	44.08±2.31
30 days	54.65±3.15^{a}	63.34±2.93^{b}	60.32±4.08^{b}	59.21±2.06
60 days	76.04±11.05^{c}	65.08±8.77^{b}	53.47±3.46^{a}	64.15±4.92
Overall	57.11±4.74 ^{NS}	58.32±4.30 ^{NS}	54.44±2.52 ^{NS}	56.62±2.26
Protein (g per 100 ml)				
0 day	6.67±0.23	6.80±0.18	7.20±0.38	6.89±0.16
30 days	7.28±0.24	7.52±0.20	7.62±0.14	7.47±0.11
60 days	6.90±0.05	6.82±0.19	6.88±0.12	6.87±0.07
Overall	6.95±0.12 ^{NS}	7.11±0.14 ^{NS}	7.23±0.15 ^{NS}	7.09±0.08
Albumin (g per 100 ml)				
0 day	3.63±0.22	3.30±0.18	3.28±0.18	3.41±0.11
30 days	3.22±0.22	3.84±0.05	3.77±0.14	3.59±0.11
60 days	3.26±0.12	3.12±0.09	2.80±0.09	3.04±0.07
Overall	3.37±0.11 ^{NS}	3.43±0.09 ^{NS}	3.28±0.12 ^{NS}	3.36±0.06
Cholesterol (mg per 100 ml)				
0 day	57.33±6.55^{b}	68.00±7.43^{c}	39.17±2.41^{a}	54.83±4.30
30 days	59.17±6.95^{b}	70.00±4.54^{c}	49.83±2.54^{a}	59.06±3.36
60 days	50.40±3.77^{a}	61.40±6.96^{b}	50.50±1.23^{a}	53.88±2.69
Overall	56.17±3.30^{b}	67.72±3.59^{c}	46.5±1.71^{a}	56.79±2.07
Creatinine (mg per 100 ml)				
0 day	1.23±0.06	1.34±0.05	1.23±0.06	1.27±0.03
30 days	1.29±0.12	1.31±0.05	1.22±0.02	1.27±0.04
60 days	0.98±0.05	0.96±0.05	1.17±0.07	1.05±0.04
Overall	1.16±0.05 ^{NS}	1.21±0.05 ^{NS}	1.20±0.03 ^{NS}	1.19±0.03
Tri-glycerides (mg per 100 ml)				
0 day	20.67±2.36	21.17±3.71	19.33±1.31	20.39±1.45
30 days	28.00±4.31^{b}	29.20±2.60^{b}	26.67±3.64^{a}	27.88±1.99
60 days	26.20±3.46^{b}	30.00±4.97^{c}	21.50±2.84^{a}	25.63±2.21
Overall	24.94±1.97^{b}	27.5±2.29^{c}	22.5±1.68^{a}	24.98±1.16

^{abc}Different superscript in different columns vary significantly at 5% level of significance.
^{NS} Non-significant in columns

Table 4. Urea and uric acid in the blood of sheep at various intervals under different system of rearing

Particulars	Extensive System	Semi-intensive system	Intensive system	Overall
Urea (mg per 100 ml)				
0 day	35.50±3.52^{a}	37.67±4.17^{a}	57.83±4.12^{b}	43.67±3.24
30 days	48.17±5.46^{c}	42.60±1.86^{b}	34.33±1.43^{a}	41.65±2.37
60 days	55.60±3.01^{a}	57.00±5.69^{a}	71.00±2.48^{b}	61.81±2.72
Overall	46.11±2.94^{a}	45.22±2.83^{a}	54.39±4.00^{b}	48.57±1.95
Uric Acid (mg per 100 ml)				
0 day	0.11±0.05^{b}	0.02±0.01^{a}	0.03±0.02^{a}	0.05±0.02
30 days	0.21±0.08^{b}	0.31±0.05^{c}	0.14±0.05^{a}	0.22±0.04
60 days	0.28±0.02^{a}	0.24±0.03^{a}	0.33±0.04^{b}	0.28±0.02
Overall	0.2±0.03 ^{NS}	0.2±0.04 ^{NS}	0.17±0.04 ^{NS}	0.19±0.02

^{abc}Different superscript in different columns vary significantly at 5% level of significance. ^{NS} Non-significant in columns

Figure 1. Percent increase in the level of various biomolecules of blood in Deccani sheep reared under different production systems

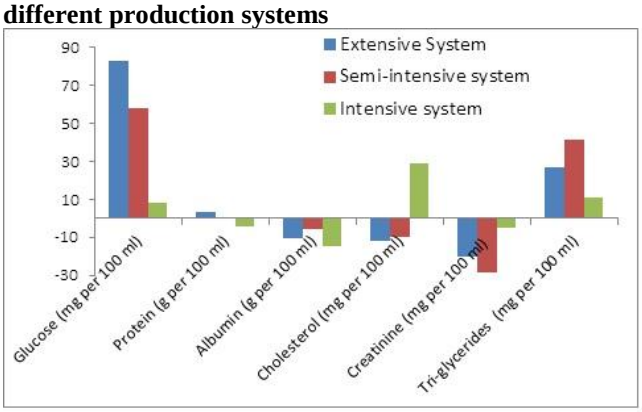
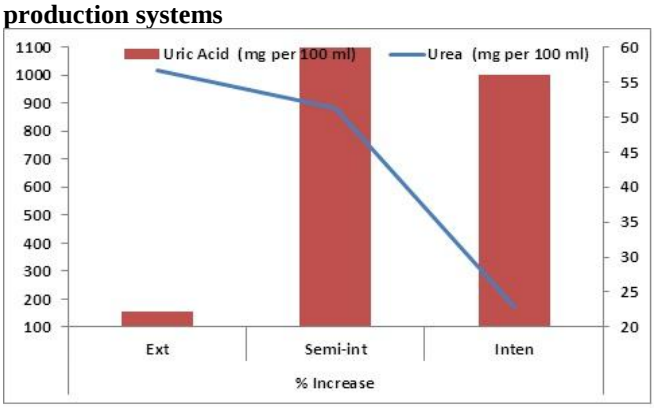


Figure 2. Percent increase in the level of urea and uric acid in blood of Deccani sheep reared under different production systems



RESULTS AND DISCUSSION

Animals kept under intensive system (9.12%) of rearing could achieve superior body weight as compared to extensive (3.87%) and semi-intensive system (6.25%) of rearing (Table-2) which has been reported by [10].

RBC and WBC count of different animals are shown in Table-2. There was no significant difference in the haematology of different groups under study. However, animals under intensive system of rearing had maximum increase in RBC Count (86.79%) as compared to semi-intensive (54.22%) and extensive (31.96%). Red blood cells (erythrocytes) serve as a carrier of haemoglobin. It is this haemoglobin that reacts with oxygen carried in the blood to form oxyhaemoglobin during respiration [11,12]. According to [5], red blood cell is involved in the transport of oxygen and carbon dioxide in the body. Thus, a reduced red blood cell count implies a reduction in the level of oxygen that would be carried to the tissues as well as the level of carbon dioxide returned to the lungs [5,13,14]. So, the vitality level has increased in the animals living under intensive system of rearing as compared to other system of rearing.

WBC count was not significantly changed in all systems of rearing, however, maximum increase was observed in animals reared under extensive system of rearing. The major functions of the white blood cell and its differentials are to fight infections, defend the body by phagocytocis against invasion by foreign organisms and to produce or at least transport and distribute antibodies in immune response. Thus, animals with low white blood cells are exposed to high risk of disease infection, while those with high counts are capable of generating antibodies in the process of phagocytocis and have high degree of resistance to diseases [14] and enhance adaptability to local environmental and disease prevalent conditions [5,15,16,17]. Since, this increase was not significant in extensive or semi-intensive system as compared to intensive system of rearing, thus in the present experiment immune status was not compromised under intensive system of rearing [18]. Concentration of plasma constituents are displayed in Table-3. Plasma glucose, protein, albumin, creatinine and Uric acid level were similar and non-significant in all the groups under experiment. So, there was no difference in the major plasma constituents in the blood of sheep reared under different system of management. However, plasma cholesterol level was significantly less and plasma triglycerides levels were significantly more in sheep under intensive system of rearing as compared to extensive and semi-intensive system of rearing.

The increase in albumin level (Table-3; Fig-1) under extensive system of rearing could be ascribed to the low protein intake during this period and dehydration [18], however, under present study no such significant change was observed.

The quantity of creatinine formed each day depends on the total body content of creatinine, which in turn depends on dietary intake, rate of synthesis of creatine, and muscle mass. In the present experiment, higher increase in level of creatinine was found in animals reared under intensive system of rearing.

Increase in Cholesterol level (Table-3; Fig-1) was found to be maximum in animals living under intensive system of rearing which could be ascribed to the higher levels of free fatty acids (FFA), caused by decreased level of stress during the experimental period [20]. The significant decrease in total cholesterol in stress has also been reported in other species: by [21] in Friesan cows at the end of pregnancy, [22] before parturition in cows and [23] in goats. So, in the present investigation, superior cholesterol condition (within physiological limits) in intensive system is suggestive of superior body condition and less stress in these systems of rearing.

Significant decrease in serum triglycerides found in this study is in accordance with increased concentration of these compounds in the ewes' liver as reported by [24]. The significant decrease in serum triglycerides in intensive system of rearing could be explained as the effect of increased lipolysis which is hormonally regulated, and not an expression of energy deficiency [25].

An increase was found in urea and uric acid content of serum (Table-4; Fig-2) at the end of extensive

system of rearing, being in contrary to a study by [26] on Tuj ewes and [19] on Sakiz-Awassi crossbreds.

CONCLUSION

In Deccani sheep, superior RBC counts as well as superior level of blood bio-molecules suggests intensive system to be better as compared to extensive and semi-intensive system of rearing.

RECOMMENDATIONS

The study was undertaken in semi-arid dryland agricultural system where frequent droughts and dependency on community pasture by small ruminants is more.

Under this system, improved immunity, superior vigour and blood bio-molecular profile found under intensive system of sheep rearing can be recommended for farmers.

ACKNOWLEDGEMENTS

The authors acknowledge the help rendered by Farm Superintendent, HRF, M. Nikhila and Rita Rani, SRFs at Animal Science Lab and then Director, Dr. B. Venkateshwarlu for supporting this work to be carried out.

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