

Evaluation of Serum Energy Metabolism and Enzyme Activity in Lactating and Non-Lactating Osmanabadi Goats from Marathwada

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Abstract

The current investigation aimed to determine the levels of energy metabolites and enzyme activity throughout the lactation phase of Osmanabadi goat. A total of 12 Osmanabadi goats, aged 3 years, were chosen for the experiment from LFC, COVAS, Udgir. These specimens were categorized into four distinct groups: Group I (control), group II (Early lactation), group III (Mid lactation), and group IV (Late lactation), each consisting of six animals. In this study, serum energy metabolites including blood glucose were not significant in lactation period. Cholesterol were reduced in all three lactation period and elevated in mid and late lactation. Total protein and albumin were higher in all three lactation period. Globulin and A: G ration were observed significantly reduced in all three groups, whereas blood urea nitrogen and ketone bodies was noted that significantly reduced in all three groups of lactation period. Triglyceride was significantly decreased in early lactation and increase in mid and late lactation. The findings from the current study lead to the conclusion that incorporating extra concentrates as a means of energy source during the early, middle, and late stages of lactation in animals is recommended to prevent negative energy balance (NEB) throughout the lactation period.

Keywords: Blood energy Metabolites, Blood Glucose, Cholesterol, Triglycerides, BUN, Total protein, Albumin, Globulin, A: G ratio, Ketone bodies and, SGOT., Osmanabadi goat

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Introduction

Goat plays a significant role in providing supplementary income and livelihood to millions of resource, poor farmers and landless laborers of rural India. Osmanabadi goat is famous breed mainly originated in Tuljapur taluka of Osmanabad District and Udgir taluka of Latur district of Marathwada region of Maharashtra, have an excellent reproductive capacity and producing milk. Osmanabadi goats are tall and large sized and their coat color varies, but 80% of its coat is black color and the rest are white, brown or spotted. 85 % of male goats are horned; female goats may be horned or poled with low milk production and dressing percentage about 45 to 50. Generally, they bred twice a year with 2 to 3 kids per breeding. Milk yield 1 to 2 liter/ day for about 4th month lactation.

Blood biochemical attributes are important indicators of the metabolic activity in lactating animals [1]. During lactation, secretary cells of mammary gland utilize 80% of the blood circulating metabolites for milk synthesis, depending on the speed of infiltration of precursors of milk compounds (i.e. free amino acids, glucose and fatty acids). The strong reduction in lipogenesis and the increased fatty acid release, supported by norepinephrine and epinephrine stimulation, induce an increase in lipase activity of mammary gland, to provide the substrates for milk fat synthesis [2]. Also, in lactating goats an increase in total protein level of serum was observed with the progress of lactation due to the catabolism of protein for milk synthesis [3].

This study aims to understand the efficiency of reproductive ability through the parameters of blood serum profiles, specifically of glucose, cholesterol, albumin, BUN, and total protein of dairy goats with a different stage of lactation. This study also aims to provide recommendations for traditional farmers regarding culling using the parameters of blood serum profiles as indicators for reproductive efficiency status. [4]. Serum energy metabolic investigation in goat may contributes much more to disease diagnosis. The primary application of AST/SGOT increase and decrease in serum level that help for detection and differential etiologic diagnosis of hepatic disease or cellular disorder [5].

Materials and Methods

The present study was conducted in the department of Veterinary Biochemistry College of Veterinary & Animal Sciences, Udgir. The experimental Osmanabadi goats were used from the established Livestock Farm Complex, COVAS, Udgir. This study comprised determination of the concentration and variations in serum energy metabolites and enzyme activity in Lactating and non-lactating Osmanabadi goats of marathwada region during Early stage, Mid stage, and Late stage of lactation.

Total 12 Osmanabadi goats were selected from LFP, Udgir. Animals were divided into two groups. Lactating and non-lactating comprise 6 animals each. Blood samples were collected from all the animals by jugular venipuncture with sodium fluoride anticoagulant for blood glucose and without anticoagulant for serum and stored at -20°C until analysis. Blood samples and serum samples were collected from both group were processes for determination of energy metabolites and enzymes. Biochemical screening of samples was carried out employing semi-auto analyzer (Micro lab RX50, India). For the remaining biochemical estimations, Erba Diagnostic kits were used. The data will be analyzed by using one-way analysis of variance (ANOVA) using SPSS software version 2.0. Further, difference between means of groups was tested using multiple comparison tests i.e. Duncan's multiple comparison test (DMRT).

Table 1a. Experimental conditions.

Group of animals	No. of animals
Control (non-lactating Animals)	6
Lactating Animals	6
Early Stage (0-45days) (Early Lactation)	
Mid Stage (46-90days) (Mid lactation)	
Late Stage (91-135days) (Late lactation)	

Results and Discussion

The data collected based on the specified parameters underwent statistical analysis and was presented in a tabular format. To elucidate and interpret the findings, relevant literature and images were included where necessary. The results of this study are elaborated under the respective biochemical parameters.

- Metabolic Profile (Blood Glucose, Cholesterol, Triglyceride, Blood Urea nitrogen, Total protein, Albumin, Globulin, and Albumin: Globulin ratio, Ketone bodies)
- Enzymes (SGOT).

Table 1b. Comparison of Mean \pm SE of serum Energy metabolites And enzyme activity in different lactating stages in comparison with control group of Osmanabadi goats of Marathwada region (n=6)

Group	Glucose (mg/dl)	Chol esterol (mg/dl)	Trigly cerides (mg/dl)	BUN (mg/dl)	Total protein (mg/dl)	Albumin (mg/dl)	Globulin (mg/dl)	A:G (mg/dl)	Ketone bodies (mg/dl)	SGOT (mg/dl)
Group I (Control)	50.48 \pm 2.16	6.96 \pm 0.07 ^b	79.88 \pm 2.55 ^{ab}	21.12 \pm 1.88 ^{ab}	5.44 \pm 0.29	2.99 \pm 0.14 ^a	2.44 \pm 0.16	1.23 \pm 0.05	2.44 \pm 0.22 ^b	64.80 \pm 2.69 ^b
Group II (Early lactating)	46.89 \pm 1.00	6.83 \pm 0.17 ^a	75.33 \pm 0.70 ^a	19 \pm 0.98 ^{ab}	6.15 \pm 0.26 ^{ab}	3.59 \pm 0.13 ^{ab}	2.64 \pm 0.18	1.37 \pm 0.07	2.34 \pm 0.16 ^{ab}	45.54 \pm 1.45 ^a
Group III (Mid lactating)	52.19 \pm 0.57	6.66 \pm 0.14 ^a	87.70 \pm 2.13 ^{bc}	13.97 \pm 0.39 ^a	7.06 \pm 0.23 ^b	4.23 \pm 0.15 ^b	2.89 \pm 0.16	1.58 \pm 0.09	1.31 \pm 0.06 ^a	48.63 \pm 1.18 ^a
Group IV (Late lactating)	51.24 \pm 0.24	7.30 \pm 0.13 ^a	94.02 \pm 1.48 ^{bc}	16.66 \pm 0.56 ^{ab}	7.08 \pm 0.48 ^b	3.79 \pm 0.27 ^{ab}	3.14 \pm 0.18	1.25 \pm 0.04	1.52 \pm 0.05 ^{ab}	52.05 \pm 7.79 ^{ab}

Means with dissimilar superscripts difference significantly.

Blood glucose

The Mean \pm SE value of serum blood Glucose in group I (control) was 50.48 \pm 2.16 and mean values of Lactating groups were 46.89 \pm 1.00, 52.19 \pm 0.57 and 51.24 \pm 0.24 in group II (Early lactation), group III (Mid lactation) and group VI (Late lactation) respectively. The Mean \pm SE value of serum blood glucose in lactating period of Osmanabadi

goat compared with non-lactating group are presented in (Table 1). The Mean \pm SE values of serum blood glucose were non significant in group II (Early lactation), group III (Mid lactation) and group IV (Late lactation) lactation period when compared to control group. In the current study, there were not significant differ in early lactation mid lactation and late lactation period when compared to control group. The present study agreement with result obtained by other researcher [6]. In Arbia goats of a semi-arid region of North-Eastern Algeria.

Cholesterol

The Mean \pm SE value of serum Cholesterol in group I (control) was 110.42 ± 12.86 and mean values of Lactating groups were 69.26 ± 3.25 , 78.37 ± 3.13 and 95.48 ± 2.04 in group II (Early lactation), group III (Mid lactation) and group VI (Late lactation) respectively. The Mean \pm SE value of serum Cholesterol in lactating period of Osmanabadi goat compared with non-lactating group are presented in (Table 1) The Mean \pm SE values of serum Cholesterol were significantly ($p < 0.01$) lower in group II (Early lactation), group III (Mid lactation) and group IV (Late lactation) lactation period when compared to control group. In current study the serum Cholesterol were significantly ($p < 0.01$) lower in early lactation, mid lactation and group late lactation period when compared to control group. Similarly; [7] found notable decrease in triglycerides and serum cholesterol concentrations in lactating female sheep and goats. Agreement result obtained by other researchers, [8] in doe and [9] in cow.

Triglyceride

Results of present experiment, showed that in this study, the Mean \pm SE value of serum Triglyceride in group I (control) was 79.88 ± 2.55 and mean values of lactating period groups were 75.33 ± 0.70 , 87.70 ± 2.13 and 94.02 ± 1.48 in group II (Early lactating), group III (Mid lactating) and group VI (Late lactating) respectively. The Mean \pm SE value of serum triglycerides in lactation period of Osmanabadi goat was compared with normal healthy group are shown in (Table 1) The Mean \pm SE value of serum triglycerides were significantly ($p < 0.01$) lower in group II (Early lactation) when compared to Control group. The Mean \pm SE value of group III (Mid lactation) and IV (late lactation) was higher when compared to group I (Control). In the current study, there were significant ($p < 0.01$) increase in the level of triglycerides in late lactation period and mid lactation when compared to control group. Similarly, [10] observed triglycerides exhibited a noteworthy elevation during the late stage of lactation in Baladi goats.

BUN

Mean \pm SE value of serum BUN in group I (control) was 21.12 ± 1.88 and mean values of lactation period groups were 19 ± 0.98 , 13.97 ± 0.39 and 16.66 ± 0.56 in group II (Early lactation), group III (Mid lactation) and group VI (Late lactation) respectively. The Mean \pm SE value of serum BUN in lactation period of Osmanabadi goat compared with normal healthy group are presented in (Table 1) The Mean \pm SE value of serum BUN significantly ($p < 0.01$) lower in Group II (Early lactation), III (Mid lactation) and group IV (Late lactation) when compared to group I (control) healthy animals. In the current study, there were significant ($p < 0.01$) decrease in the level of BUN in early lactation, mid lactation and late lactation when compared to control healthy animals. Increase in the level of BUN when compared with early lactation and late lactation. Similarly, [11] observed that, there may be an association between protein and BUN levels in early and late lactation ($P < 0.05$). The drop in feed intake during the kidding due to stress and hormonal changes may be linked to the fall in serum BUN around parturition.

Total Protein

The Mean \pm SE value of serum total protein in group I (control) was 5.44 ± 0.29 and mean values of lactation period groups were 6.15 ± 0.26 , 7.06 ± 0.23 and 7.08 ± 0.48 in group II (Early lactation), group III (Mid lactation) and group VI (Late lactation) respectively. The Mean \pm SE value of serum total protein in lactation period of Osmanabadi goat compared with normal healthy group are presented in (Table 1) The Mean \pm SE value of serum total protein significantly ($p < 0.05$) were higher in II (Early lactation), Group III (Mid lactation) and group IV (Late lactation) as compared to group I (control) healthy animals. Serum total protein for group Group III (Mid lactation) and IV (Late lactation) could not significantly stand out when compared statistically. In the current study, Total protein levels significantly ($p < 0.05$) were higher in Early lactation, Mid lactation and Late lactation as compared to group control healthy animals. According to earlier research, [12] and [13] there were significant drops in serum total protein levels as lactation progressed.

Albumin

The Mean \pm SE value of serum Albumin in group I (control) was 2.99 ± 0.14 and mean values of lactation period groups were 3.59 ± 0.13 , 4.23 ± 0.15 and 3.79 ± 0.27 in group II (Early lactation), group III (Mid lactation) and group VI (Late

lactation) respectively. The Mean \pm SE value of serum total protein in lactation period of Osmanabadi goat compared with normal healthy group are presented in (Table 1). The Mean \pm SE value of serum albumin significantly ($p < 0.01$) were higher in II (Early lactation), Group III (Mid lactation) and group IV (Late lactation) as compared to group I (control) healthy animals. Serum albumin for group II (Early lactation) and IV (Late lactation) could not significantly stand out when compared statistically. In the current study, there were significantly ($p < 0.01$) higher level of albumin in Early lactation, Mid lactation and Late lactation as compared to group control healthy animals. Similarly, [1] observed that the decrease in plasma albumin in dry period when compared with the onset of lactation in ewes.

Globulin

The Mean \pm SE value of serum globulin in group I (control) was 2.44 ± 0.16 and mean values of lactation period groups were 2.64 ± 0.18 , 2.89 ± 0.16 and 3.14 ± 0.18 in group II (Early lactation), group III (Mid lactation) and group VI (Late lactation) respectively. The Mean \pm SE value of serum globulin in lactation period of Osmanabadi goat compared with normal healthy group are presented in (Table 1). The Mean \pm SE value of serum globulin is not significantly difference between the groups when compared group II (Early lactation), Group III (Mid lactation) and group IV (Late lactation) with group I (control) healthy animals. However, the values remain in normal physiological limit. In the current study, there were no significant difference in lactating stages as compared to group control healthy animals. The present study is in agreement with the result obtained by other researchers, [11] observed the lack of significance for globulin levels during the early stages of lactation can be attributed to the process of protein breakdown for the synthesis of milk.

Albumin: Globulin ratio

The Mean \pm SE value of serum Albumin: Globulin ratio in group I (control) was 1.23 ± 0.05 and mean values of lactation period groups were 1.37 ± 0.07 , 1.58 ± 0.09 and 1.25 ± 0.04 in group II (Early lactation), group III (Mid lactation) and group VI (Late lactation) respectively. The Mean \pm SE value of serum albumin: globulin ratio in lactation period of Osmanabadi goat compared with normal healthy group are presented in (Table 1).

The Mean \pm SE value of serum albumin: globulin ratio is not significantly differ between the groups when compared group II (Early lactation), Group III (Mid lactation) and group IV (Late lactation) with group I (control) healthy animals. However, the values remain in normal physiological limit. In the current study, there were no significant difference in lactating stages as compared to group control healthy animals. Similarly; [14] observed the A/G ratio does not exhibit a significant difference between pregnant and lactating thin-tailed sheep; however, there is a tendency for the A/G ratio in lactating thin-tailed sheep to be lower when compared to the A/G ratio in pregnant thin-tailed sheep ($P > 0.05$).

Ketone bodies

The Mean \pm SE value of serum Ketone bodies in group I (control) was 2.44 ± 0.22 and mean values of lactation period groups were 2.34 ± 0.16 , 1.31 ± 0.06 and 1.52 ± 0.05 in group II (Early lactation), group III (Mid lactation) and group VI (Late lactation) respectively. The Mean \pm SE value of serum Ketone bodies in lactation period of Osmanabadi goat compared with normal healthy group are presented in (Table 1). The Mean \pm SE value of serum Ketone bodies significantly ($p < 0.01$) were lower in II (Early lactation), Group III (Mid lactation) and group IV (Late lactation) as compared to group I (control) healthy animals. Serum ketone bodies for group Group III (Mid lactation) and IV (Late lactation) could not significantly stand out when compared statistically, similarly group I (control) and II (Early lactation). In the current study, there were significantly ($p < 0.01$) decline in Early lactation, mid lactation and late lactation as compared to control group healthy animals was suggestive of negative energy balance. Similarly; [15] diminished the levels of serum beta-hydroxybutyrate (BHBA) observed throughout the various phases of lactation in cows imply their adaptation to a condition characterized by a depletion of energy reserves.

The Mean \pm SE value of serum SCOT in group I (control) was 64.80 ± 2.69 and mean values of lactation period groups were 45.54 ± 1.45 , 48.63 ± 1.18 and 52.05 ± 7.79 in group II (Early lactation), group III (Mid lactation) and group VI (Late lactation) respectively. The Mean \pm SE value of serum SGOT in lactation period of Osmanabadi goat compared with normal healthy group are presented in (Table 1). The Mean \pm SE value of serum SGOT significantly ($p < 0.01$) were lower in II (Early lactation), Group III (Mid lactation) and group IV (Late lactation) as compared to group I (control) healthy animals. Similarly; [6] decline observed in AST levels during lactation in comparison to the dry period is unlikely to be attributed to malnutrition, as blood glucose levels remained stable. The rise in AST activity detected in the bloodstream of goats during the dry period suggested an augmentation in hepatic metabolic processes.

Conclusion

To avoid the condition of negative energy balance (NEB) commonly seen during transition period, based on the results observed in present investigation, it can be concluded that the inclusion of additional concentrates as a source of energy and mineral mixture at early, mid, and late lactation periods of animal is advocated.

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