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## Impact of lactation stage on body weight, body condition score and blood composition of Attappady black and malabari goats

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### Abstract

The objective of the study was to evaluate the Influence of lactation stage on body weight, body condition score and serum blood biochemical parameters (protein, cholesterol and triglycerides) of Attappady Black and Malabari goats under Indian conditions. Thirty newly kidded does of Attappady Black and ten newly kidded does of Malabari goats were selected for this study. Body weight and body condition score was assessed together with blood samples, which were collected at first on seventh day of lactation and then every three weeks interval of the does till the end of lactation. Body condition score of each doe was also assessed. The overall mean body weight differed significantly ( $P<0.05$ ) between the Attappady Black and Malabari goats. The overall average BCS was different significantly ( $P<0.01$ ) between the Attappady Black and Malabari goats. The blood samples of total protein and serum triglycerides were not influenced ( $P>0.05$ ) by breeds. However, serum cholesterol ( $P<0.01$ ) differed significantly between the breeds. Serum cholesterol concentrations were higher in blood of Attappady Black than Malabari goats. But Malabari goat had relatively higher in serum protein and serum triglycerides than Attappady Black goats.

**Keywords:** Body weight, BCS, blood composition, lactation stage, attappady black, malabari, goats

### Introduction

Goat extensive system has an important social and economic role in emphasizing marginal areas due to goat's particular ability for browsing poor pastures in dry environments giving high biological value products (Decandia *et al.*, 2005) [5]. The sales policy of the animals are mostly fixed by the basis of government schemes in organised government farms but in the local markets its mostly based on the body weight and Body Condition Score (BCS) of the animals. So the body weight and BCS is the main managemental tool to sales the animals. (Aumont *et al.*, 1994, Wilson *et al.*, 1997, Slippers *et al.*, 2000, Ngwa *et al.*, 2007 and Mendizabal *et al.* 2011) [4, 18, 21, 26, 33]. BCS is an important factor for predicting the production performance of the farm animals (Cabiddu *et al.*, 1999, Mushtaq *et al.*, 2012, Susilorini *et al.*, 2014) [5, 20, 28]. BCS is a simple and quick process for assess the body condition score of the goats and indicates the available fat reserves on body which can be used to determine the nutritional and health status of the goats. (Villaquiran *et al.*, 2004) Goats which have a low BCS in early lactation will not produce a better milk production because of the negative energy reserve in the body and goat which have higher BCS or more fat on kidding time can leads to more health problem. The BCS range of sheep and goat is 1 to 5 (Susilorini *et al.*, 2014) [28]. The ideal score of BCS of the goat is 3 – 3.5. It has the positive relationship with the production performance and health status of the animals. Blood biochemical attributes *viz.*, total protein, cholesterol and Triglycerides are the important indicator of the health, nutritional status and metabolic activity in the lactating animal (Karapehliyan *et al.*, 2007) [14]. The biochemical parameters are mostly used to diagnosis the various animal diseases which affect the production ability of the animals (Addass *et al.*, 2010) [1]. The biochemical value of the animal can vary with various lactation stages are reported by several researchers (El - Sherif *et al.*, 2001, Zumbo *et al.*, 2007, Celi *et al.* 2008, Sadjadian *et al.*, 2013, Tharwat *et al.*, 2013, Zebari *et al.*, 2013, Manat *et al.*, 2016) [6, 12, 17, 24, 29, 34, 35]. During lactation the mammary gland cells are utilizing 80% of the blood metabolites to produce the milk synthesis depending on the speed of infiltration of precursors of milk compounds (i.e. free amino acids, glucose and fatty acids) (Zebari *et al.*, 2013) [35].

The milk precursors like protein, lactose and fat are produced by the mammary gland cells. The changes of milk composition and decreased milk yield was noticed when the decrease production of blood metabolite (Karapehivan *et al.*, 2007) [14]. So, the present investigation was planned to study the influence of lactation stage on body weight, body condition score and blood metabolism on Attappady Black and Malabari goats.

## Materials and Methods

### Location of the study

The research was carried out in the ex-situ conservation units of Attappady black goats in Kerala Veterinary and Animal Sciences University. The units are, University Goat and Sheep farm, College of Veterinary and Animal Sciences, Mannuthy. The station is located at longitude of 76°15' E and latitude of 10°31' N and at altitude of 30 m above the sea level and Livestock Research Station, Thiruvazhankunnu which is located at longitude of 76°36' E and latitude of 11°03' N and at altitude of 35 m above the sea level.

### Management

Animals were maintained under semi-intensive method with morning hours (6h) grazing and feeding seasonally available green fodder with concentrate mixture at the rate of 500g/day. The study was conducted for a period of seven months from October 2016 to April 2017.

### Sample analysis

Live body weight of selected animals were taken individually as per Parasram (2014) and the animals were assessed for

BCS as per Godara *et al.*, (2016) at first on seventh day of lactation and then every three weeks interval of the does till the end of lactation. Blood samples, (10 ml), were withdrawn from jugular vein of each doe and stored in vacuum glass tubes containing no anticoagulant. Blood samples were collected at first on seventh day of lactation and then every three weeks interval until the end of lactation. The serum samples were separated within an hour by centrifugation at 4 °C for 10 minutes at 3000 rpm and stored in plastic tubes at -55 °C. The serum samples were used to determine the total protein, cholesterol and triglyceride (TG) by using Semi-Automated Biochemical Analyzer (Roshma, 2014) [23].

### Statistical analysis

Data obtained on the experiment were subjected to statistical analysis as per Snedecor and Cochran (1994) and results were interpreted.

## Result and Discussion

### Body weight

The average body weight of experimental animals recorded at every three weeks interval until the end of lactation is documented in Table 1. The overall mean body weight differed significantly ( $P < 0.05$ ) between the Attappady Black and Malabari goats. Between the two breeds, body weight was significantly higher ( $P < 0.01$ ) in Malabari goats in weeks 1 to 10 of lactation stages and the body weight significantly ( $P < 0.01$ ) varied between the various stages of lactation in both breeds. The highest body weight was observed in 1<sup>st</sup> week ( $28.93 \pm 0.52$  kg) of lactation in Attappady Black and Malabari ( $33.30 \pm 0.68$  kg) goats.

**Table 1:** Body weight of attappady black and malabari goats during lactation

Stages of lactation (In weeks)	Body weight (Kg)		t-value	p-value
	Attappady black (n = 30)	Malabari (n = 10)		
1	$28.93 \pm 0.52^a$	$33.30 \pm 0.68^a$	4.480**	<0.001
4	$27.93 \pm 0.47^{abc}$	$32.59 \pm 0.47^{ab}$	5.347**	<0.001
7	$27.35 \pm 0.57^{bc}$	$31.97 \pm 0.73^a$	4.316**	<0.001
10	$26.68 \pm 0.49^c$	$31.58 \pm 0.71^a$	5.217**	<0.001
13		$30.94 \pm 0.85^{bc}$		
16		$30.36 \pm 0.64^c$		
F-value	4.920**	6.002**		
p-value	0.003	<0.001		
Mean	$27.72 \pm 0.26$	$31.82 \pm 0.30$	9.518*	0.01

\*\*Significant at 1% level, \* Significant at 5% level and means with same lower case as superscripts have no significant difference between the weeks

The body weight of Attappady Black goats during weeks 1, 4, 7 and 10 of lactation and the body weight of Malabari goats during weeks 1, 4, 7, 10, 13 and 16 of lactation were represented in Table 1. The body weight differed ( $P < 0.01$ ) significantly within the breeds of various lactation stages and between the breeds on weeks 1, 4, 7 and 10 of lactation stages. The results are in accordance with Singh and Ludri (2002) [17, 25] who reported the highest body weight was noticed in the early lactation and the lowest body weight occurred in the late lactation in crossbred goats. In contrary to present findings, Atasoglu *et al.* (2009) [3] who reported that the body weight of the Sannan goats was not significantly ( $p=0.1599$ ) differing during the lactation periods. In the present study the body weight decreased as lactation progress in both the breeds. This might be due to negative energy balance during the lactation period of the animals and other reasons are higher parity, older age and intensive milk feeding to kids are associated with greater weight loss after

postpartum among the goats.

The mean body weight recorded during the experimental period was  $27.72 \pm 0.26$  and  $31.82 \pm 0.30$  kg for Attappady Black and Malabari goats respectively. Similar to present finding, Verma *et al.* (2009) [31] who stated the mean body weight of adult Malabari does were 30.68 kg. Similarly, Stephen *et al.* (2005) [27] noted the mean body weight of Attappady Black goat was  $31 \pm 0.4$  kg. In contrary to present finding, Chitra *et al.* (2012) [7] reported the body weight of adult Malabari does was  $24.23 \pm 0.73$  kg which were lower than the present findings and the body weight variation might be due to breed characteristics of the animals.

### Body condition score

Summarized data of BCS on experimental period of Attappady Black and Malabari does are listed in Table 2. The overall average BCS was different significantly ( $P < 0.01$ ) between the Attappady Black and Malabari goats. Between

the two breeds, body condition score was significantly higher ( $P < 0.01$ ) in Malabari goats in week 1 but not in weeks 4, 7 and 10 of lactation stages and the body condition score significantly ( $P < 0.01$ ) varied within both breeds during various stages of lactation. The highest BCS was observed in 10<sup>th</sup> week ( $1.98 \pm 0.05$ ) and 16<sup>th</sup> week ( $2.30 \pm 0.08$ ) of lactation in Attappady Black and Malabari does respectively. The BCS of Attappady Black goats during weeks 1, 4, 7 and 10 of lactation and the body weight of Malabari goats during weeks 1, 4, 7, 10, 13 and 16 of lactation were represented in Table 2. The BCS differed ( $P < 0.01$ ) significantly within the breeds of various lactation stages and there is no significant difference between the breeds on weeks 4, 7 and 10 except 1<sup>st</sup> ( $P < 0.01$ ) week of lactation stages. The present finding was in accordance with the results obtained by Cabiddu *et al.* (1999) [5] who reported the BCS increased as the lactation progressed. Similarly, Darwesh *et al.* (2013) [10] observed the lower BCS in early lactation and then the BCS significantly ( $P < 0.05$ ) increased at mid as well as late stages of lactation. But the results were in contrary to the findings of Atasever *et*

*al.* (2015) [2] who reported there was no significant difference between the stages of lactation and BCS in Turkish Sannan goats. In the present study, BCS increased as lactation progressed. This might be due to the goats in early lactation the body fat secure was require to concede them to mobilize energy for huge milk production. So after kidding the animal could be accredited to the negative energy balance. Therefore the BCS of early lactation was lower than the mid and late lactation.

The observed average BCS was less in Attappady Black ( $1.73 \pm 0.03$ ) when compared to Malabari ( $2.00 \pm 0.04$ ) goats. The present finding was in agreement with Valentine *et al.* (2015) [30] who reported the mean BCS of northwestern goats of India were  $1.78 \pm 0.02$ . Similarly, Darwesh *et al.* (2013) [10] reported the average BCS of black goats was  $2.35 \pm 0.08$ . In contrary to present finding, Atasever *et al.* (2015) [2] who reported the average BCS of Turkish Sannan goats was  $2.98 \pm 0.22$  which were higher than the present findings and the changes of BCS on breeds might be due to genetic potential of the animals.

**Table 2:** Body condition score of attappady black and malabari goats during lactation

Stages of lactation (In weeks)	Body condition score (1-5 scale)		t-value	p-value
	Attappady black (n = 30)	Malabari (n = 10)		
1	$1.40 \pm 0.05^d$	$1.75 \pm 0.08^c$	3.515**	<0.001
4	$1.68 \pm 0.16^c$	$1.85 \pm 0.16^b^c$	1.362	0.866
7	$1.83 \pm 0.06^b$	$1.95 \pm 0.09^b^c$	1.069	0.212
10	$1.98 \pm 0.05^a$	$2.00 \pm 0.07^b^c$	0.170	0.866
13		$2.15 \pm 0.16^{ab}$		
16		$2.30 \pm 0.08^a$		
F-value	32.015**	4.909**		
p-value	<0.001	<0.001		
Mean	$1.73 \pm 0.03$	$2.00 \pm 0.04$	5.062**	<0.001

\*\*Significant at 1% level,\*Significant at 5% level and means with same lower case as superscripts have no significant difference between the weeks

### Serum total protein

The average serum total protein of experimental animals recorded at every three weeks interval until the end of lactation is documented in Table 3. The overall serum total protein content was fairly comparable ( $p > 0.05$ ) between the two breeds and also between the two breeds on weeks 1, 4, 7

and 10 of lactation stages. But it had a significant ( $P < 0.01$ ) difference within both breeds during various lactation stages. The highest serum total protein content (g/dl) was observed in 1<sup>st</sup> week ( $9.47 \pm 0.29$ ) of lactation in Attappady Black and Malabari ( $9.77 \pm 0.44$ ) does.

**Table 3:** Serum total protein value of attappady black and malabari goats during lactation

Stages of lactation (In weeks)	Serum total protein (g/dl)		t-value	p-value
	Attappady black (n = 30)	Malabari (n = 10)		
1	$9.47 \pm 0.29^a$	$9.77 \pm 0.44^a$	0.525	0.602
4	$8.76 \pm 0.20^b$	$8.41 \pm 0.33^{cde}$	0.888	0.380
7	$8.13 \pm 0.26^c$	$8.40 \pm 0.32^e$	0.542	0.591
10	$8.12 \pm 0.30^{bc}$	$8.40 \pm 0.31^{de}$	0.494	0.624
13		$9.44 \pm 0.23^a$		
16		$9.12 \pm 0.15^{acd}$		
F-value	8.623**	6.083**		
p-value	<0.001	<0.001		
Mean	$8.62 \pm 0.14$	$8.92 \pm 0.14$	1.512	0.133

\*\*Significant at 1% level,\*Significant at 5% level and means with same lower case as superscripts have no significant difference between the weeks

The average serum total protein content of Attappady black and Malabari goats were  $8.62 \pm 0.14$  and  $8.92 \pm 0.14$  g/dl respectively. The total protein concentration in this study was slightly higher than the reference ranges (6.3-8.5 g/dl) as reported by Daramola *et al.* (2005) [9]. The results obtained in this present study were in accordance with Pradhan (2016) [22] who reported the serum protein content of  $8.4 \pm 0.59$  and  $8.4$

$\pm 1.33$  g/dl in Ganjam and Bolangir kids respectively. In contrary to present finding, Elitok, (2012) [11] who reported the serum total protein content was  $75.76 \pm 2.33$  g/dl in female goats which was higher than the present findings and Mohammed *et al.* (2016) [19] found the values of total protein in Damascus, Black Aradi, White Aradi and Barbari breeds were  $6.42 \pm 0.80$ ,  $6.76 \pm 0.34$ ,  $6.17 \pm 0.52$  and  $6.98 \pm 1.07$

g/dl respectively which was lower than the present findings. Serum total protein differed ( $P<0.01$ ) significantly within the breeds of various lactation stages but there is no significant ( $p>0.05$ ) difference between the breeds on weeks 1, 4, 7 and 10 of lactation stages. The serum protein of Attappady Black goats during weeks 1, 4, 7 and 10 of lactation and the serum protein of Malabari goats during weeks 1, 4, 7, 10, 13 and 16 of lactation were represented in Table 3. Consonant results were reported by Zebari *et al.* (2013) [35] who stated the peak total protein value was noticed in the early lactation followed by late lactation and mid lactation in meriz goat. In contrary to present finding, El-Sherif *et al.* (2001) [14] and Celi *et al.* (2008) [6] reported the serum total protein content had no significant ( $p>0.05$ ) different during the lactation period. In the present study the serum proteins of lactating ewes declined may be explained by the sharp decrease in globulin

as lactation progressed, because the globulin content was used for formation of milk protein and antibodies.

### Serum cholesterol

Serum cholesterol content of experimental animals is represented in Table 4. The Mean serum cholesterol content was significantly ( $P<0.01$ ) higher for Attappady Black than Malabari goats. Between the two breeds, of Serum cholesterol content was significantly higher in Attappady Black goats in weeks 1, 10 ( $P<0.01$ ) and 4 ( $P<0.05$ ) of lactation stages. The Serum cholesterol content significantly ( $P<0.01$ ) differed within both breeds during various stages of lactation. 1<sup>st</sup> week of lactation had highest serum cholesterol content ( $142.77 \pm 5.19$  mg/dl) in Attappady Black and 4<sup>th</sup> week ( $108.00 \pm 4.12$  mg/dl) of lactation had higher value in Malabari goats.

**Table 4:** Serum cholesterol value of attappady black and malabari goats during lactation

Stages of lactation (In weeks)	Serum cholesterol (mg/dl)		t-value	p-value
	Attappady black (n = 30)	Malabari (n = 10)		
1	$142.77 \pm 5.19^a$	$102.79 \pm 4.01^{ab}$	6.093**	<0.001
4	$121.47 \pm 3.50^b$	$108.00 \pm 4.12^{af}$	2.060*	0.046
7	$99.54 \pm 3.38^c$	$94.36 \pm 1.81^{bd}$	0.865	0.393
10	$129.74 \pm 4.09^b$	$73.09 \pm 5.36^c$	7.305**	<0.001
13		$85.06 \pm 2.94^{eg}$		
16		$93.28 \pm 5.97^{dfg}$		
F-value	21.393**	10.511**		
p-value	<0.001	<0.001		
Mean	$123.38 \pm 2.49$	$92.77 \pm 2.23$	9.161**	<0.001

\*\*Significant at 1% level,\*Significant at 5% level and means with same lower case as superscripts have no significant difference between the weeks

The mean serum cholesterol content observed in the present study was  $123.38 \pm 2.49$  and  $92.77 \pm 2.23$  mg/dl for Attappady Black and Malabari goats respectively. The total cholesterol concentration in this study fall in the reference range (40.1-127.3 mg/dl) reported by Kiran *et al.* (2012) [16]. The present finding was in agreement with the results obtained by Ikhimioya and Imasuen (2007) [13] who studied the effect of *Panicum maximum* feed on the blood cholesterol in female West African dwarf goats and reported the mean serum cholesterol value was  $103.55$  mg dL<sup>-1</sup>. Similarly, Pradhan (2016) [22] reported the average serum cholesterol content was  $2.9 \pm 0.02$  mmol/ L in Ganjam goats. In contrary to present finding, Elitok *et al.* (2012) [11] who reported the average serum cholesterol content of Sannan goats were  $31.08 \pm 1.64$  mg/dl and Khan *et al.* (2013) [20] reported the average serum cholesterol content of does in Ghizre district and Baltistan area was  $66.25 \pm 1.72$  and  $79.86 \pm 2.47$  mg dL<sup>-1</sup> respectively which were lower than the present findings. The serum cholesterol content of Attappady Black goats during weeks 1, 4, 7 and 10 of lactation and the serum cholesterol content of Malabari goats during weeks 1, 4, 7, 10, 13 and 16 of lactation were represented in Table 4. Serum cholesterol content differed ( $P<0.01$ ) significantly within the breeds during various lactation stages and between the breeds in weeks 1 and 10 ( $P<0.01$ ) and 4 ( $P<0.05$ ) but not in 7<sup>th</sup> week of lactation. The results are in correspondence with Zumbo *et al.* (2007) [34] who noted that the total cholesterol content significantly decreased ( $P<0.001$ ) at 60, 90, 120 days compared to 30<sup>th</sup> day of lactation. Similarly, Tharwat *et al.* (2013) [29] found the higher cholesterol content in 1<sup>st</sup> week of lactation in goats. In contrary to present finding, Celi *et al.* (2008) [6] noted that the serum cholesterol value did not differ significantly during the lactation period and Zebari *et al.*

(2013) [35] found that the peak cholesterol content was noticed in the late stage of lactation followed by mid stage of lactation and early stage of lactation in meriz goats. In the present study, the cholesterol value decreased during early and mid-lactation then it attained stability in late lactation. This might be due to increased cholesterol uptake by tissue which is involved in milk synthesis in early to mid-lactation.

### Serum triglycerides

Summarized data of serum triglyceride content of Attappady Black and Malabari does are listed in Table 15. The overall mean serum triglyceride content was not significantly ( $p>0.05$ ) different between the breeds and also between the two breeds in weeks 1, 4, 7 and 10 of lactation stages. But it had a significant ( $P<0.01$ ) difference within the breeds during various lactation stages. The highest serum triglycerides content (mg/dl) was observed in 10<sup>th</sup> week ( $44.60 \pm 2.11$ ) of lactation in Attappady Black and 16<sup>th</sup> week ( $49.94 \pm 3.38$ ) of lactation in Malabari goats.

The mean serum triglyceride (mg/dl) content respectively in Attappady Black and Malabari goats were  $37.24 \pm 1.15$  and  $40.52 \pm 1.68$ . The triglyceride concentration in this study fell within the reference range (0.16-1.6 mmol/L) as reported by Daramola *et al.* (2005) [9]. But, findings were contrary to Elitok *et al.* (2012) [11] reported the average serum triglycerides content of Sannan goats were  $58.11 \pm 3.10$  mg/dl which were higher than the present findings and Khan *et al.* (2016) [20] reported the average serum triglycerides content of  $0.51 \pm 0.01$  mmol/ L in Maraz goats which were lower than the present findings.

The serum triglycerides content of Attappady Black goats during weeks 1, 4, 7 and 10 of lactation and the serum triglycerides content of Malabari goats during weeks 1, 4, 7

10, 13 and 16 of lactation were represented in Table 5. Serum triglycerides differed ( $P < 0.01$ ) significantly within the breeds of various lactation stages but there is no significant ( $p > 0.05$ ) difference between the breeds in weeks 1, 4, 7 and 10. These results are agreed with the findings of Zumbo *et al.* (2007) [34] who stated the triglycerides content had a significant increase ( $P < 0.01$ ) in the 150<sup>th</sup> days of lactation compared to 30, 60, 90 and 120 days of lactation. Similarly, Zebari *et al.* (2013) [35] found that the triglyceride value had significant ( $P < 0.05$ )

difference between the lactation period. In contrary to present finding, Darwesh *et al.* (2013) [10] who reported there is no significant ( $p > 0.05$ ) difference in lactation stage and triglycerides content of black goats. In the present study, the triglyceride content increased as lactation progressed. It might be due to consistency with increased energy demand and negative energy balance and the effect of increased lipolysis which is hormonally regulated in early lactation. So the early lactation had lower triglyceride content.

**Table 5:** Serum triglyceride value of attappady black and malabari goats during lactation

Stages of lactation (In weeks)	Serum triglyceride (mg/dl)		t-value	p-value
	Attappady black (n = 30)	Malabari (n = 10)		
1	32.37 ± 2.48 <sup>b</sup>	32.64 ± 3.96 <sup>cde</sup>	0.057	0.955
4	34.37 ± 1.90 <sup>b</sup>	30.20 ± 3.56 <sup>d</sup>	1.077	0.288
7	37.63 ± 2.09 <sup>b</sup>	36.95 ± 2.42 <sup>ce</sup>	0.175	0.862
10	44.60 ± 2.11 <sup>a</sup>	45.03 ± 3.83 <sup>c</sup>	0.100	0.921
13		48.36 ± 3.43 <sup>b</sup>		
16		49.94 ± 3.38 <sup>a</sup>		
F-value	9.925**	8.940**		
p-value	<0.001	<0.001		
Mean	37.24 ± 1.15	40.52 ± 1.68	1.629	0.105

\*\*Significant at 1% level, \*Significant at 5% level and means with same lower case as superscripts have no significant difference between the weeks

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