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## Impact of lactation stage on milk 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 milk composition of Attappady Black and Malabari goats. Newly kidded thirty does of Attappady Black and ten Malabari goats were selected for this study. The does were hand milked daily at 8 am prior to feeding and yield measured for each animal at weekly interval. The milk samples of each animal was collected in experimental period and analysed for total solids, fat, crude protein, lactose and ash. Results showed that fat, total solids, lactose and ash were not influenced by breeds. However, protein content was differed significantly ( $P < 0.01$ ) between the small ruminant breeds. Total solids, fat, protein and lactose concentrations were higher in milk of Attappady Black than in Malabari goats.

**Keywords:** Milk composition, stage of lactation, attappady black, malabari goats

#### Introduction

Goat is generally portrayed as a “poor man’s cow”. Milk of all the dairy animals have the same principle components called fat, protein, SNF and minerals but the components are variable on within the species (Qeshlagh *et al.*, 2016) as well as breeds. There are various components are affecting the milk yield and composition of the goats, *viz.*, breed, nutrition, stage of lactation, environment and health condition of animals. so the determination of the milk composition is important for improve the productivity and quality of the production. Goat milk composition differs from other mammalian milk in terms of alkalinity, better digestibility, buffering capacity and its nutraceutical purpose (George, 1981) <sup>[10]</sup>. Hence, goat milk is endorsed for infants, old and rejuvenated peoples. The composition and functional properties of milk had a greater importance for dairy industry and the composition of goat milk determines its nutritional values and technological properties of milk and milk product because of its processing ability is highly influenced by composition. Therefore, this study was undertaken with consequent objectives to compare the milk yield, lactation length and milk composition of Attappady Black and Malabari goats.

#### Methods and Materials

##### 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, Thiruvazhamkunnu 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 animals were maintained in slated floor type. The study was conducted for a period of seven months.

##### Sample analysis

Animals were hand milked once daily (08.00am) and the quantity of milk harvested from each doe was measured by using graduated plastic container (1000 ml capacity) as per Mahmoud *et al.* (2014) until the end of lactation. The Milk samples (approximately 100 ml) were collected from all does in clean and sterile plastic container at first on seventh day of lactation and

then every three weeks interval of the does till the end of lactation and was analysed for total solids, fat, lactose, ash (BIS, 1981) and protein (AOAC, 2012).

### Statistical analysis

Data obtained in the experiment were subjected to statistical analysis as per Snedecor and Cochran (1994) [15] and results were interpreted. Within each breed, comparison between weeks was done by using repeated measures ANOVA followed by LSD and between breed comparisons in every week was done by using independent t – test with using of SPSS. 20.0 version.

## Results and Discussion

### Milk composition

#### Total solids

Total solid content in milk of Attappady Black and Malabari does on various lactation stages are summarized in Table 1. Total solids content differed ( $P<0.01$ ) significantly within the breeds of various lactation stages and it significantly ( $P<0.01$ ) differed between the breeds in 7 and 10<sup>th</sup> weeks but not in 1<sup>st</sup> and 4<sup>th</sup> week of lactation. These results are in agreement with Peris *et al.* (1997) [13] and Mewstaw *et al.* (2012) [11]. They reported the total solids content were deferred significantly between the stages of lactation in Murciano Granadina Boer goats, Cross, Arsi – Bali and Somali goats respectively. In contrary to the present finding, Zahraddeen *et al.* (2009) [17]

and Addass *et al.* (2013) [1] noted the total solids did not differed significantly during the stages of lactation on Nigeria goat and Sokoto Red, Sahel goat, West African dwarf goats respectively. In this study, the considerable increase in the total solids content in the end of lactation may be due to decreasing the milk yield of the lactating animals or dilution effect of milk yield.

The overall milk total solids was fairly comparable ( $p>0.05$ ) between the Attappady Black and Malabari goats. Between the two breeds, total solids content was significantly higher ( $P<0.01$ ) in Attappady Black goats in weeks 7 and 10 but not in 1<sup>st</sup> and 4<sup>th</sup> weeks of lactation stages. The total solids content varied ( $P<0.01$ ) significantly within both breeds during various stages of lactation. Attappady Black had highest total solids percentage in 10<sup>th</sup> week of lactation whereas in Malabari goat it was at 16<sup>th</sup> week of lactation. The present finding of Mean milk total solids content (per cent) was compared favorably with the value of 13.57 per cent reported by Azeze *et al.* (2015) [5] in Ethiopia goats, Pal *et al.* (1997) in Marwari goats and Darwesh *et al.* (2013) [6] in black goats. But, the findings contrary to Simos *et al.* (1991) [14] who observed the higher total solids content of the Greek goats compare than the present findings and Agnihotri and Rajkumar (2007) [2] stated the average total solids content in Sirohi, Marwari and Kutchi does had lower than the present findings.

**Table 1:** Milk total solids content of attappady black and malabari goats during lactation

Stages of lactation (In weeks)	Total solids (%)		t-value	p-value
	Attappady black (n = 30)	Malabari (n = 10)		
1	13.60 ± 0.17 <sup>b</sup>	13.63 ± 0.15 <sup>ab</sup>	0.097	0.923
4	12.09 ± 0.15 <sup>d</sup>	12.25 ± 0.11 <sup>d</sup>	0.532	0.598
7	13.02 ± 0.16 <sup>c</sup>	11.40 ± 0.10 <sup>e</sup>	8.413**	<0.001
10	14.47 ± 0.11 <sup>a</sup>	13.03 ± 0.19 <sup>c</sup>	6.443**	<0.001
13		13.40 ± 0.15 <sup>b</sup>		
16		14.02 ± 0.13 <sup>a</sup>		
F-value	59.804**	52.035**		
p-value	<0.001	<0.001		
Mean	13.30 ± 0.10	12.95 ± 0.10	1.907	0.06

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

#### Fat

Data of milk fat content of experimental animals in various lactation stages are presented in Table 2. The milk fat content differed significantly ( $P<0.01$ ) within the breeds of various lactation stages and between the breeds in weeks 1 ( $P<0.05$ ), 7 and 10 ( $P<0.01$ ) but not in 4<sup>th</sup> week.

The present results are in congruence with the findings of Singh and Ludri (2002) [16] in crossbred goats and Guzeler *et al.* (2010) [9] in Sannan x kills goats. In the present study, the

decrease milk fat content of goats is mainly attributed to a decrease in the acetic acid molar proportion and increase in the propionic acid molar proportion in the rumen and generally a higher milk production is associated with a decrease in milk constituent. The animal which producing high milk yield, it produce low level of fat content in milk and animal which produce high milk fat content it produce low level of milk yield.

**Table 2:** Milk fat content of attappady black and malabari goats during lactation

Stages of lactation (In weeks)	Fat content (%)		t-value	p-value
	Attappady black (n = 30)	Malabari (n = 10)		
1	4.76 ± 0.09 <sup>b</sup>	4.32 ± 0.15 <sup>b</sup>	2.393*	0.022
4	3.68 ± 0.08 <sup>d</sup>	3.50 ± 0.12 <sup>d</sup>	1.199	0.238
7	4.09 ± 0.10 <sup>c</sup>	3.46 ± 0.13 <sup>d</sup>	3.182**	0.003
10	5.22 ± 0.10 <sup>a</sup>	4.42 ± 0.22 <sup>bc</sup>	3.822**	<0.001
13		4.78 ± 0.12 <sup>c</sup>		
16		5.39 ± 0.22 <sup>a</sup>		
F-value	64.127**	17.919**		
p-value	<0.001	<0.001		
Mean	4.44 ± 0.07	4.31 ± 0.10	0.976	0.330

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

The overall milk fat content was fairly comparable ( $p>0.05$ ) between the Attappady Black and Malabari goats. Between the two breeds, fat content was significantly higher ( $P<0.01$ ) in Attappady Black goats in weeks 1 ( $P<0.05$ ), 7 and 10 ( $P<0.01$ ) but not in 4<sup>th</sup> week of lactation. The fat content differed ( $P<0.01$ ) significantly within both breeds during various lactation stages. Attappady Black had highest fat percentage in 10<sup>th</sup> week of lactation whereas in Malabari goat it was at 16<sup>th</sup> week of lactation. The present finding of mean fat (per cent) content was compared favorably with Agnihotri and Rajkumar (2007) [2]. But, the results were contrary to Nirmalan and Nair (1962) [12] and Devendra *et al* (1979) [7] they reported the Malabari goats had higher fat per cent than the present findings.

### Protein

Summarized data of milk protein content of Attappady Black and Malabari does on various lactation stages are listed in Table 3. Protein content differed ( $P<0.01$ ) significantly within the breeds of various lactation stages and it significantly ( $P<0.05$ ) differed between the breeds in weeks 4, 7 and 10<sup>th</sup> week but not in 1<sup>st</sup> week of lactation stages. Similar results were reported by Antunac *et al.* (2001) [4] and Mewstaw *et al.*

(2012) [11] noted the stage of lactation had significant ( $P<0.01$ ) difference in crossbred goats and Boer goats, Cross, Arsi – Bali and Somali goats respectively. In contrary to the result, Singh and Ludri (2002) [16] and El-Tarabany *et al.* (2016) [8] reported the milk protein was not statistically different between different stages of lactation in cross bred goats. The substantial increase in the protein content in the end stage of lactation may be due to decreasing the milk yield of the goats.

The overall milk protein content differed significantly ( $P<0.01$ ) between the Attappady Black and Malabari goats. Between the two breeds, milk protein content was significantly higher ( $P<0.05$ ) in Attappady Black in weeks 4, 7 and 10 but not in 1<sup>st</sup> week of lactation. The highest protein content (per cent) of Attappady Black and Malabari goats was noticed in 1<sup>st</sup> and 16<sup>th</sup> week of lactation respectively. Present results on the mean milk protein content of does are in agreement with Simos *et al.* (1991) [14] in native Greek goats and Azeze *et al.* (2015) [5] in Ethiopia goats. In contrary to the results, Nirmalan and Nair (1962) [12] and Devendra *et al* (1979) [7] they reported the Malabari goats had higher protein per cent than the present findings.

**Table 3:** Milk protein content of attappady black and malabari goats during lactation

Stages of lactation (In weeks)	Protein (%)		t-value	p-value
	Attappady black (n = 30)	Malabari (n = 10)		
1	3.87 ± 0.07 <sup>a</sup>	3.69 ± 0.13 <sup>ab</sup>	1.357	0.183
4	3.55 ± 0.06 <sup>c</sup>	3.24 ± 0.11 <sup>d</sup>	2.560*	0.015
7	3.58 ± 0.06 <sup>c</sup>	3.38 ± 0.12 <sup>c</sup>	1.596*	0.119
10	3.76 ± 0.05 <sup>b</sup>	3.47 ± 0.11 <sup>ce</sup>	2.529*	0.016
13		3.62 ± 0.10 <sup>bc</sup>		
16		3.73 ± 0.10 <sup>a</sup>		
F-value	31.882**	15.991**		
p-value	<0.001	<0.001		
Mean	3.68 ± 0.03	3.52 ± 0.05	2.946**	0.004

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

### Lactose

Data of milk lactose content of experimental animals on various lactation stages are represented in Table 4. Milk lactose content was not differing significantly within the breeds of various lactation stages and between the breeds in weeks 1, 4, 7 and 10. Similar results were reported by Singh and Ludri (2002) [16]. In contrary to the result, Zahraddeen *et al.* (2009) [17] and Addass *et al.* (2013) [1] reported that the lactose content was significantly affected by the stage of lactation in cross bred and indigenous goats in Nigeria. The lactose content in present study was the most constant component of milk. So it abides by its role as an osmotic regulator and a compensator for changes of all other

components. The overall milk lactose content was fairly comparable ( $p>0.05$ ) between the Attappady Black and Malabari goats, between the two breeds ( $p>0.05$ ) in weeks 1, 4, 7, 10 of lactation stages and within the both breeds ( $p>0.05$ ) of various lactation stages. The highest lactose percentage was observed in 1<sup>st</sup> week of lactation in Attappady Black and Malabari does respectively. The mean lactose content of both breeds of the present study is in concordance with Simos *et al.* (1991) [14] in native Greek goats and Azeze *et al.* (2015) [5] in Ethiopia goats. In contrary to the results of the present study, Darwesh *et al.* (2013) [6] in black goats and Upadhyay *et al.* (2013) [16] in rohilkhand goats reported the lactose content was lower than the present study.

**Table 4:** Milk lactose content of attappady black and malabari goats during lactation

Stages of lactation (In weeks)	Lactose (%)		t-value	p-value
	Attappady black (n = 30)	Malabari (n = 10)		
1	4.85 ± 0.06 <sup>a</sup>	4.76 ± 0.12 <sup>a</sup>	0.666	0.509
4	4.78 ± 0.07 <sup>a</sup>	4.70 ± 0.09 <sup>a</sup>	0.640	0.526
7	4.82 ± 0.07 <sup>a</sup>	4.78 ± 0.13 <sup>a</sup>	0.287	0.776
10	4.75 ± 0.07 <sup>a</sup>	4.80 ± 0.08 <sup>a</sup>	0.502	0.620
13		4.81 ± 0.06 <sup>a</sup>		
16		4.82 ± 0.07 <sup>a</sup>		
F-value	0.635	0.385		
p-value	0.594	0.875		
Mean	4.80 ± 0.03	4.78 ± 0.04	0.421	0.675

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

## Ash

Ash content of milk in both goat breeds on various lactation stages was recorded and summarized in Table 5. Milk ash content was not different significantly within the breeds of various lactation stages and between the breeds in weeks 1, 4, 7 and 10. Similar results were reported by Agnihotri and Rajkumar (2007) [2]. In contrary to the result, Antunac *et al.* (2001) [4] and Ahamefula *et al.* (2012) [3] reported that the ash content was highly significant ( $P < 0.01$ ) with stages of lactation.

The overall milk ash content was not differed significantly between Attappady Black and Malabari goats. The highest ash percentage was observed in 7<sup>th</sup> week of lactation in Attappady Black and 10<sup>th</sup> week of lactation in Malabari does. The mean milk ash content results were in consonance with findings of Simos *et al.* (1991) [14] and Agnihotri and Rajkumar (2007) [2] in native Greek goats and Jakhrana goats. In contrary to the result, Agnihotri and Rajkumar (2007) [2] who reported the average ash content of Sirohi, Marwari and Kutchi breeds was higher than the present findings.

**Table 5:** Milk ash content of attappady black and malabari goats during lactation

Stages of lactation (In weeks)	Ash (%)		t-value	p-value
	Attappady black (n = 30)	Malabari (n = 10)		
1	0.75 ± 0.04 <sup>a</sup>	0.73 ± 0.04 <sup>a</sup>	0.550	0.586
4	0.74 ± 0.03 <sup>a</sup>	0.77 ± 0.03 <sup>a</sup>	0.490	0.627
7	0.78 ± 0.04 <sup>a</sup>	0.74 ± 0.03 <sup>a</sup>	0.847	0.403
10	0.75 ± 0.03 <sup>a</sup>	0.79 ± 0.04 <sup>a</sup>	0.655	0.517
13		0.75 ± 0.03 <sup>a</sup>		
16		0.76 ± 0.03 <sup>a</sup>		
F-value	0.456	0.370		
p-value	0.714	0.867		
Mean	0.76 ± 0.03	0.76 ± 0.04	0.02	0.985

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

## Correlation between the experimental parameters of attappady black goats

Overall correlation matrix (Table 6) of Attappady Black goats indicated significant positive and negative ( $P < 0.05-0.01$ ) correlations between the experimental parameters. The total solids were significantly positive correlate with milk

components of fat and protein. The present finding was agreed with Addass *et al.* (2013) [11] who reported the positive correlation value of (0.49) total solids and protein content. Similarly, Petlane *et al.* (2013) who stated the total solids content significantly positive correlate with fat and protein content.

**Table 6:** Correlation coefficients between the experimental parameters of attappady black goats

Components	TS	MF	MP	ML	Ash
TS	1				
MF	0.562**	1			
MP	0.342**	0.145	1		
ML	0.105	-0.046	0.056	1	
Ash	0.004	0.067	-0.023	-0.238	1

TS, total solids; MF, milk fat; MP, milk protein; ML, milk lactose. \*\*Significant at 1% level, \*Significant at 5% level

## Correlation between the experimental parameters of malabari goats

Overall correlation matrix (Table 7) of Malabari goat indicated significant positive and negative ( $P < 0.05-0.01$ ) correlations between the experimental parameters. The total solids were significantly positive correlated with milk

components of fat and protein. The present finding agreed with Addass *et al.* (2013) [11] who reported the positive correlation value of (0.49) total solids and protein. Similarly, Petlane *et al.* (2013) who stated the total solids content has significantly positive correlate with fat and protein content.

**Table 7:** Correlation coefficients between the experimental parameters of malabari goats

Components	TS	MF	MP	ML	Ash
TS	1				
MF	0.619**	1			
MP	0.203	0.362**	1		
ML	0.011	0.007	-0.003	1	
Ash	0.057	-0.049	-0.144	-0.029	1

TS, total solids; MF, milk fat; MP, milk protein; ML, milk lactose. \*\*Significant at 1% level, \*Significant at 5% level

## Conclusion

The chemical composition of milk on Attappady Black and Malabari goats had a significant effect in various lactation periods. In general terms, the overall composition and milk yield had a similar relation in all among the goat breeds in India. However, the specific knowledge about Attappady Black and Malabari goats has gained and it can be used for

improve the management of the goat breeds in India.

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