



E-ISSN: 2320-7078  
P-ISSN: 2349-6800  
JEZS 2018; 6(6): 86-90  
© 2018 JEZS  
Received: 25-09-2018  
Accepted: 27-10-2018

#### K Chinnamani

Department of Livestock  
Production Management  
Veterinary College and Research  
Institute Namakkal, Tamil  
Nadu, India

#### V Ramesh Saravana Kumar

Department of Livestock  
Production Management  
Veterinary College and Research  
Institute Namakkal, Tamil  
Nadu, India

#### J Muralidharan

Department of Livestock  
Production Management  
Veterinary College and Research  
Institute Namakkal, Tamil  
Nadu, India

#### AK Thiruvankadan

Department of Livestock  
Production Management  
Veterinary College and Research  
Institute Namakkal, Tamil  
Nadu, India

#### K Sivakumar

Department of Livestock  
Production Management  
Veterinary College and Research  
Institute Namakkal, Tamil  
Nadu, India

#### V Ramesh

Department of Livestock  
Production Management  
Veterinary College and Research  
Institute Namakkal, Tamil  
Nadu, India

#### Correspondence

##### K Chinnamani

Department of Livestock  
Production Management  
Veterinary College and Research  
Institute Namakkal, Tamil  
Nadu, India

## Growth, production and reproduction performance of Salem black goats under intensive and semi-intensive systems of management in Tamil Nadu

K Chinnamani, V Ramesh Saravana Kumar, J Muralidharan, AK Thiruvankadan, K Sivakumar and V Ramesh

#### Abstract

Biology of brinjal shoot and fruit borer, *Leucinodes orbonalis* (Guenee), a major pest of brinjal was studied in the year 2015-2016 in the laboratory. The incubation period was  $4.10 \pm 0.88$  days. Length and breadth were  $0.64 \pm 0.04$  and  $0.35 \pm 0.02$  mm, respectively. The duration of 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup>, 4<sup>th</sup> and 5<sup>th</sup> larval instar was  $1.33 \pm 0.48$ ,  $2.77 \pm 0.43$ ,  $2.56 \pm 0.72$ ,  $0.3 \pm 0.85$  and  $3.50 \pm 0.80$  days, respectively. The total larval duration was  $13.20 \pm 1.15$  days, prepupal period  $1.44 \pm 0.50$  days and the pupal period  $8.7 \pm 0.75$  days. The full grown larvae measured  $14.09 \pm 1.01$  mm in length and  $3.34 \pm 0.21$  mm in breadth. The total developmental period was  $27.43 \pm 1.75$  days. The adult longevity of the male and female was  $3.27 \pm 0.45$  days and  $5.23 \pm 0.73$  days, respectively. The pre-oviposition, oviposition and post oviposition periods were  $1.17 \pm 0.38$ ,  $2.53 \pm 0.51$  and  $2.63 \pm 0.67$  days, respectively. Body length of male and female was  $8.54 \pm 0.90$  and  $11.01 \pm 0.71$  mm, respectively. The fecundity was  $160.2 \pm 32.42$  eggs per female and the sex ratio was 1:1.40 (male to female).

A study was undertaken on growth, productive and reproductive performance of Salem black goats under the intensive and semi-intensive system of management using 40 kids. The overall body weights at birth, 3, 6, 9 and 12 months of age under intensive system were  $2.18 \pm 0.07$ ,  $8.20 \pm 0.36$ ,  $13.51 \pm 0.46$ ,  $17.92 \pm 0.48$  and  $18.67 \pm 0.52$  Kg, respectively. Similarly, under semi-intensive system the values were  $2.05 \pm 0.08$ ,  $7.35 \pm 0.23$ ,  $13.53 \pm 0.44$ ,  $17.19 \pm 0.45$  and  $18.14 \pm 0.62$  Kg, respectively. Under intensive system, the reproductive performance namely, weight at first mating, number of services per conception, weight at first kidding, litter size, gestational weight gain, lactational weight loss, service period, kidding percentage and kidding interval were  $17.32 \pm 0.31$  kg,  $1.58 \pm 0.22$ ,  $21.97 \pm 0.69$  kg,  $1.00.00$ ,  $4.65 \pm 0.23$ kg,  $3.13 \pm 0.48$ kg,  $94.00 \pm 3.86$  days,  $100.00$ ,  $245.34 \pm 4.11$  days, respectively. The same values for semi-intensive system were  $17.55 \pm 0.51$  kg,  $1.67 \pm 0.19$ ,  $22.17 \pm 0.67$ kg,  $1.33 \pm 0.14$ ,  $4.62 \pm 0.23$ kg,  $2.73 \pm 0.35$ ,  $97.50 \pm 0.34$  days,  $100.00$ ,  $248.27 \pm 4.74$  days. There was no twinning noticed in intensive system and observed as 33.33 percentages in semi-intensive system.

**Keywords:** Salem Black goat, growth, reproductive performance, different systems

#### Introduction

Salem Black goats are hardy in nature and it can grow up well under the drought condition and serve as a source of income to large number of landless labourers, small and marginal farmers in Salem, Dharmapuri, Krishnagiri, Erode, Tirupur, Namakkal and Karur districts of Tamil Nadu. The approximate goat population in these districts as per 2012 census was 18,21,009 which was 22.36 per cent of the total goat population in Tamil Nadu. The browsing habits and adaptation to harsh climates of goats makes them useful in these areas.

The productivity of goats under the prevailing traditional production system is very low it is because they are maintained under the extensive system on natural vegetation on degraded common grazing lands and tree lopping. Even these degraded grazing resources are shrinking continuously. Therefore, goat rearing took a shift to intensive from conventional systems. The aim of the present investigation was therefore to study the growth and reproduction performance of Salem black goats.

#### Materials and Methods

The kids were given an adaptation period of 15 days before the start of the experiment. The group T<sub>2</sub> was sent for grazing. The T<sub>1</sub> group was kept under stall feeding. Stall-fed kids were offered concentrate feed, Co-4 grass (Bajra X Napier hybrid variety), subabul (*Leucaena*

*leucocephala*), sorghum (*Sorghum bicolor*) stover, ground nut haulms (*Arachis hypogaea*) at different times of the day to meet the nutrient requirement as per the nutrient requirements recommended by [11]. Subabul fodder was cut into small branches of minimum stem portion and fed fresh. Sorghum stover was also chopped and fed as dry fodder. Groundnut haulms were fed as such. Co-4 and sorghum stover were fed two times a day, whereas, subabul was fed once a day. *Ad libitum* drinking water was made available.

The kids were allowed for grazing from 9.00 a.m. to 4.30 p.m. The males were grazed separately and maintained in separate pens. The grazing land of the institution was having *Cenchrus* pasture, naturally growing grasses (*Heteropogon contortus*, *Cynodon dactylon*, *Deschampsia cespitosa*, *Echinochola colona*), Shrubs (*Ageratum houstonianum*, *Bambusa vulgaris*, *Colotropis gigantean* and *Canna indica*) and tree fodders (*Azadirachta indica*, *Albizia lebbek*, *Acacia leucophloea*, *Leucaena leucocephala*, *Gliricidia sepium* and *Ficus religiosa*).

### Housing

The kids were housed in open type of housing with an asbestos roofed, earthen floor shed with partition made of chain link material. Pegs made of iron were placed in each partition. Intensive group animals were tethered individually, so that feed intake and left over from each animal could be measured accurately. Semi-intensive group of animals were tied up to the iron pegs in the morning before feeding. After recording the left over feed, they were sent for grazing.

### Data collection

The following parameters namely, daily feed intake, body weight at fortnightly intervals of six male kids were recorded. In females, the reproductive parameters were collected. They are weight at first mating, weight at first kidding, birth weight, weaning weight, kidding interval, litter size, number of service per conception, twinning percentage, kidding percentage and service period. The data thus collected were compiled and analyzed as per [29]. The data on body weight, and average daily gain (ADG) were subjected to one way analysis of variance under completely randomized design. For comparisons of body weight, dry matter intake, body weight gain, feed conversion ratio and per cent feed efficiency between groups, the students "t" - test was used.

## Results and Discussion

### Productive performance

The body weight of Salem Black kids showed increased gains, as a result of supplementation with no significant difference between the rearing groups during the 150 days of the growth trial. In both the intensive and semi-intensive groups, the initial body weight has increased linearly as the age advanced. Initial body weight of intensively reared kids was  $14.18 \pm 0.89$  kg for male and  $13.05 \pm 0.48$  kg for females, respectively and in semi-intensive system it was  $14.18 \pm 0.80$  kg and  $13.09 \pm 0.50$  kg for male and females, respectively. The final body weight of Salem Black kids at 150 days study period of male and female in intensive group was  $23.08 \pm 0.79$  and  $18.58 \pm 0.46$  kg, respectively and in semi-intensive group it was  $21.91 \pm 0.75$  and  $18.52 \pm 0.66$  kg, for male and female, respectively. The body weight of Salem Black was comparable to the other Tamil Nadu breeds like Kodi adu [13], Kanni Adu [33], Pallai Adu [23].

The ADG of male kids in intensive and semi-intensive system

was  $58.09 \pm 5.04$  and  $50.49 \pm 4.32$  g, respectively and for females, it was  $36.17 \pm 1.35$  and  $35.45 \pm 2.23$  g, respectively. The comparison of weight gain in male and female kids revealed that males attained better growth than female kids. The present study revealed no significant difference between intensive and semi-intensive system. In contrary, [15] reported had significantly higher body weight in crossbred goat of Assam, grazing with supplementation than intensively reared goat, [1] in kanni Adu kids; and [4] in Black Bengal kids.

### Growth performance

The birth weight of Salem Black males (2.18 kg) and females (2.05 kg) obtained in the present study was lower than the values observed in Salem Black [34, 8] and Kanni Adu, Kodi Adu and crossbred goats of Tamil Nadu [33, 31, 36].

The overall weaning weight of intensive and semi-intensive kids was  $8.20 \pm 0.36$  and  $7.35 \pm 0.23$  kg, respectively the observed value was comparable with values reported by [34] on the same breed. However [7, 8] reported higher weaning weight for the same breed in its home tract. The weaning weights observed was lower than the values observed for Kanni Adu and Kodi Adu goats of Tamil Nadu [13, 33, 36].

The six (13.51kg) and nine months(17.92kg) body weights observed in the present study were higher than the reports on the same breed [7, 34, 8, 14] and other goat breeds of Tamil Nadu. [33, 24, 36]

Whereas, at twelve months, the body weight of Salem Black female goats in intensive and semi-intensive rearing was  $18.67 \pm 0.52$  and  $18.14 \pm 0.62$  kg, respectively with no significant difference between the rearing systems. But observed in the present study was comparable with the report by [34]. Slightly lower than the present values was also reported on the same breed [7, 8]. The higher than the present value was also reported in other goat breeds of Tamil Nadu. [24, 33, 36]

### Dry matter intake

The cumulative DMI was  $82.63 \pm 2.14$  kg for males  $69.35 \pm 1.13$  kg for females. The higher DMI in males could be due to faster body growth observed in male kids grows during pre as well as postnatal development. [31] Results of this study indicated that the male kids gained significantly ( $P < 0.01$ ) higher weights than female kids during all the stages which might be due to quantitative difference in the secretion of growth and sex hormones [6].

### Feed conversion ratio

The present study male animals showed comparatively better FCR ( $10.57 \pm 0.65$ ) than females ( $11.64 \pm 0.90$ ). In Salem Black goats, the FCR was numerically better in male animals than females. However, [28] observed better ( $P < 0.01$ ) FCR in male Jamunapari goats than females. The differences between sexes would be attributed to the nutritional status and the genetic potential of the animals used in the corresponding studies [25].

### Weight at first mating

The effect of rearing system on weight at first mating is shown in (Table 1). There was no significant difference in intensive system and semi-intensive system. The present study observed the weight at first mating in intensive and semi-intensive system was  $17.32 \pm 0.31$  kg and  $17.55 \pm 0.51$  kg, respectively. The present findings for weight at first mating agreed with report of [20] in Mehsana goat, [17] in Kutchi goat [10] in Jamunapari goat [2, 5], in Black Bengal goat. Observed lowered value in Black Bengal goat than the values observed for Salem Black goat in the present study.

**Table 1.** Mean ( $\pm$  SE) of reproductive performance of Salem Black goats under intensive and semi- intensive systems

Parameters	Intensive system (T <sub>1</sub> )	Semi-intensive system (T <sub>2</sub> )	T-value	P-value
Weight at first mating (kg)	17.32 $\pm$ 0.31(12)	17.55 $\pm$ 0.51 (12)	0.393 <sup>NS</sup>	0.349
Number of services per conception	1.58 $\pm$ 0.22 (12)	1.67 $\pm$ 0.19 (12)	0.281 <sup>NS</sup>	0.391
Weight at first kidding (kg)	21.97 $\pm$ 0.69(12)	22.17 $\pm$ 0.67 (12)	0.208 <sup>NS</sup>	0.418
Litter size	1.00 $\pm$ 0.00 <sup>a</sup> (12)	1.33 $\pm$ 0.14 <sup>b</sup> (12)	2.345 <sup>*</sup>	0.019
<b>Birth weight (kg)</b>				
Male	2.20 $\pm$ 0.06 (8)	2.23 $\pm$ 0.08 (8)	0.228 <sup>NS</sup>	0.412
Female	2.15 $\pm$ 0.17 (4)	1.88 $\pm$ 0.09 (8)	1.391 <sup>NS</sup>	0.111
Overall	2.18 $\pm$ 0.07 (12)	2.05 $\pm$ 0.08 (16)	1.290 <sup>NS</sup>	0.104
<b>Weaning weight (kg)</b>				
Male	8.43 $\pm$ 0.41 <sup>b</sup> (8)	7.53 $\pm$ 0.24 <sup>a</sup> (8)	1.904 <sup>*</sup>	0.041
Female	7.75 $\pm$ 0.74 (4)	7.18 $\pm$ 0.42 (8)	0.677 <sup>NS</sup>	0.264
Overall	8.20 $\pm$ 0.36 <sup>b</sup> (12)	7.35 $\pm$ 0.23 <sup>a</sup> (16)	1.970 <sup>*</sup>	0.031
Gestational weight gain (kg)	4.65 $\pm$ 0.23 (12)	4.62 $\pm$ 0.23(12)	0.103 <sup>NS</sup>	0.459
Dam weight at the time of weaning (kg)	18.84 $\pm$ 0.36(12)	19.44 $\pm$ 0.35(12)	1.189 <sup>NS</sup>	0.124
Lactational weight loss (kg)	3.13 $\pm$ 0.48 (12)	2.73 $\pm$ 0.35 (12)	0.746 <sup>NS</sup>	0.464
Service period (days)	94.00 $\pm$ 3.86 (12)	97.50 $\pm$ 0.34 (12)	1.848 <sup>NS</sup>	0.198
Kidding percentage	100.00 (12)	100.00 (12)	-	-
Twinning percentage	0	33.33 (4)	-	-
Kidding interval (days)	245.34 $\pm$ 4.11 (12)	248.27 $\pm$ 4.74(12)	0.468	0.324

Means bearing the different superscript within a row differ significantly, \*Significant (P<0.05), <sup>NS</sup> Non-significant.

### Number of services per conception

The overall mean of the number of services per conception in intensive and semi-intensive was shown in (Table 1). The present study revealed that the number of service per conception of the intensive and semi-intensive system was 1.58  $\pm$  0.22 and 1.67  $\pm$  0.19, respectively. System of management did not significantly influence the services per conception. The present study was closely agreed with<sup>[2]</sup> in Black Bengal goat who reported semi-intensively reared goat was 1.45 and <sup>[30]</sup> in native sheep of Bangladesh who reported semi-intensively reared sheep was 1.40 numbers.

### Weight at first kidding

The overall means for weight at first kidding were shown in (Table 1). In the present study, the values were found to be 21.97  $\pm$  0.69 and 22.17  $\pm$  0.67 kg in intensive and semi-intensive system, respectively. The systems of management had no significant effect on weight at first kidding. The non-significant effect of system of management was in accordance with the reports on Jamunapari and Mehsana goats <sup>[10, 20]</sup>. However, <sup>[19, 5]</sup> reported significantly higher weight at first kidding in intensively reared goats compared to semi-intensively reared goats.

### Litter size

The litter size observed in the present study was 1.00  $\pm$  0.00 and 1.33  $\pm$  0.14 under the intensive and semi-intensive system. It is close agreement with the reports of Kanni Adu (1.70  $\pm$  0.60), Black Bengal (2.33  $\pm$  0.33) and Salem Black (1.48  $\pm$  0.13) goats <sup>[32, 12, 9]</sup>.

### Gestational weight gain

The gestational weight gain of the intensive and semi-intensive system was 4.65  $\pm$  0.23 and 4.62  $\pm$  0.23 kg, respectively are shown in Table 1. It is similar to the reports of <sup>[35]</sup> in Mecheri sheep maintained under organized farm conditions.

### Lactational weight loss

The lactation weight loss of intensive and semi-intensive system was 3.13  $\pm$  0.48 and 2.73  $\pm$  0.35 kg, respectively. The present value was comparable with <sup>[12]</sup> in Black Bengal goat

and the values are lower than the reports of <sup>[35]</sup> in Mecheri sheep of Tamil Nadu under farm conditions.

### Service period

The overall means of service period was in intensive and semi-intensive system was 94.00  $\pm$  3.86 and 97.50  $\pm$  0.34 days, respectively are shown in Table 1. The present observed service period was comparable with Sangamneri goat <sup>[3]</sup> and Berari goat <sup>[16]</sup> and shorter than other Indian goat breeds like Sirohi goat <sup>[21]</sup>, Mehsana goat <sup>[20]</sup>, Ganjam goat <sup>[22]</sup>.

### Kidding percentage

The kidding percentage of Salem Black goats under intensive and semi-intensive system was 100 per cent and 100 per cent. All the kids were given birth reared under intensive and semi-intensive system of management in the present study. However, the reports of <sup>[17, 27, 19]</sup> revealed system of management significantly influences the kidding percentage.

### Twinning percentage

The twinning percentage of Salem Black goats under intensive and semi-intensive system was 0 and 33.33 per cent, respectively. The values observed in the present study were in agreement with the reports of <sup>[34, 9]</sup> on the same breed. The multiple birth percentage observed in this study was lower than the value reported for the Kanni Adu goats <sup>[32, 13]</sup>.

### Kidding interval

Kidding interval in Salem Black goat under intensive and semi-intensive system was 245.34 $\pm$ 4.11 and 248.27  $\pm$ 4.74 days, respectively (Table1). The observed kidding interval in the present study was comparable with Kodi Adu (8 to 10 months) <sup>[13]</sup>, Pallai Adu (7.75  $\pm$  0.42) <sup>[23]</sup>, Salem Black goat (8 to 10 months) <sup>[9]</sup> and Berari goats (240.86  $\pm$  1.94) <sup>[16]</sup>. However higher values reported by earlier authors <sup>[18, 21, 26]</sup>. The lower values observed in the present study was <sup>[32]</sup> in Kanni Adu goat and <sup>[34]</sup> in Salem Black goat.

### Conclusion

Result revealed that the productive and reproductive performance of Salem Black goats reared under intensive and semi-intensive systems of management had no significant

difference between rearing systems, and observed numerically higher body weight in male compared to female in both the systems. There was not obtained twins in intensive system. It is possible to provide better grazing land in semi-intensive system it will be more twinning obtained.

#### Acknowledgements

The authors are thankful to Tamil Nadu Veterinary and Animal Sciences University, Chennai for providing necessary facilities, funds and support to carry out the research work.

#### References

1. Chellapandian M, Balachandran S. Effect of concentrate supplementation on the body weight gain of range managed kids. *Indian Journal of Small Ruminants*. 2003; 9(1):71-72.
2. Chowdhury SA, Bhuiyan MSA, Faruk S. Rearing Black Bengal goat under semi-intensive management. 1. Physiological and reproductive performances. *Asian Australian Journal of Animal Science*. 2002; 15(4):477-484.
3. Deokar DK, Lawar VS, Pawar BK, Andhale RR. Breed characteristics of Sangamneri goat. *Indian Journal of Small Ruminants*. 2007; 13(2):213-215.
4. Dey A, Samajdar T, Gangopadhyay PK. Growth performance and carcass traits of Black Bengal kids (*Capra hircus*) supplemented with homemade concentrate mixture reared under extensive system of management. *Indian Journal of Animal Nutrition*. 2014; 31(4):411-413.
5. Faruque S, Chowdhury SA, Siddiquee NU, Afroz MA. Performance and genetic parameters of economically important traits of Black Bengal goat. *Journal of Bangladesh Agricultural University*. 2010; 8(1):67-78.
6. Gopal Dass, Production performance and management practices of Pugal sheep in the home tract. *Indian Journal of Animal Sciences*. 2007; 77(8):763-766.
7. Gopu P. Genetic Characterization of Salem Black goat. M.V.Sc thesis submitted to the Tamil Nadu Veterinary and Animal Sciences University, Chennai, 2002.
8. Gopu P, Rajendran R, Raman KS, Thangaraju, P. Distribution and characteristics of Salem Black goat, In: compendium of National symposium on Redefining role of Indigenous Animal Genetic resources in rural development, held at Bangalore, 2008, 198-199.
9. Gopu P, Raman KS, Thangaraju P, Saravanan R Panneerselvam S. Breed characteristics of Salem Black goat in Tamil Nadu. *Shanlax International Journal of Veterinary Science*. 2013; 1(1):15-19.
10. Hassan MR, Talukder MAI and Sultana S. Evaluation of the production characteristics of the Jamunapari goat and its adaptability to farm conditions in Bangladesh. *Bangladesh Veterinarian*. 2010; 27(1):26-35.
11. ICAR. Nutrient Requirements of Sheep, Goat and Rabbit. Indian Council of Agriculture Research, Krishi Anusandhan Bhawan, Pusa, New Delhi, 2013.
12. Islam MR, Amin MR, Kabir AKMA Ahmed MU. Comparative study between semi-intensive and scavenging production system on the performance of Black Bengal goat. *Journal of Bangladesh Agricultural University*. 2009; 7(1):79-86.
13. Jain A, Sahana G, Kandasamy N and Nivsarkar AE. Kodi adu - A new goat breed of Tamil Nadu. *Indian Journal of Animal Sciences*. 2000; 70(6):649-651.
14. Jayanthi D. Studies on growth performance, carcass characteristics and meat quality of Salem Black goat. Ph.D., Thesis submitted to the Tamil Nadu Veterinary and Animal Sciences University, Chennai. 2015.
15. Khound S, Saikia S, Bora JR. Effect of management system on growth performance and behavior of crossbred goat of Assam. *Indian Journal of Small Ruminants*. 1995; 1(2):12-16.
16. Krantikharkar, Kuralkar SV, Prajakta Kuralkar. Growth, production and reproduction performance of Berari goats in their native tract. *Indian Journal of Small Ruminants*. 2014; 20(1):12-15.
17. Kumar A, Sushilkumar, Mishra AK, Singh VK. Characteristics of Kutchi goats of Gujarat. *Indian Journal of Small Ruminants*. 2006; 12(2):162-168.
18. Maroof Ahmad, Singh PK, Sadana DK. Alam S, Chahal D. Reproductive performance of Beetal goats in its breeding tract. *Indian Journal of Small Ruminants*. 2007; 13(2):182-185.
19. Patel AK, Mathur BK, Kaushish SK. Kidding performance of arid goat breeds under different management systems. *Indian Journal of Small Ruminants*. 2005; 11(2):140-144.
20. Patel AC, Pandey DP. Growth, production and reproduction performance of Mehsana goat. *Journal of Livestock Science*. 2013; 4:17-21.
21. Pathodiya OP, Gurjar ML, Singh SK. Reproductive performance of Sirohi goats in field conditions. *Indian Journal of Small Ruminants*. 2008; 14(1):124-126.
22. Rao PK, Dash SK, Singh MK, Rai B, Singh NP. Ganjam goat of Orissa and its management practices. *Indian Journal of Small Ruminants*. 2009; 15(1):44-50.
23. Ravimurugan T, Devendran P, Cauveri D, Balachandran S. Performance of Indigenous goat (Pallai Adu) under field conditions. *Tamil Nadu Journal of Veterinary and Animal Sciences*. 2009; 5(5):203-207.
24. Report. Annual Report of Tamil Nadu Veterinary and Animal Sciences University, Tamil Nadu. 2002,44.
25. Sen A.R, Santra A, and Karim SA. Carcass yield, composition and meat quality attributes of sheep and goat under semiarid conditions, *Meat Science*. 2004; 66:757-763.
26. Singh KP, Dixit SP, Singh PK, Pandey DP, Ahilawat SPSA note on growth and reproduction traits of Mehsana goats under farmers flock. *Indian Journal of Small Ruminants*. 2009a; 15(2):271-273.
27. Singh MK, Rai B, Ashok Kumar, Simaria MB, Singh NP. Performance of Zalawadi goats under range conditions. *Indian Journal of Animal Sciences*. 2009b; 79(6):68-72.
28. Singh MK, Dutta TK, Sharma RB, Das AK, Singh NP. Evaluation of growth, feed conversion efficiency and carcass traits of Jamunapari goats under intensive feeding system. *Indian Journal of Animal Sciences*. 2010; 80(4):382-384.
29. Snedecor GW, Cochran WG. *Statistical Methods*. 8<sup>th</sup> Edition. The Iowa state university press, Ames, Iowa, USA, 1996.
30. Sultana N, Hasan MN, Iqbal A, Ershaduzzoman M, Talukdar MAL, Dey S. Effect of intensive and semi-intensive feeding system on productive and reproductive performance of native sheep. *Journal of Science and Research*. 2011; 3(3):693-698.
31. Soundararajan C, Sivakumar T. Factors affecting birth weight of Tellicherry kids. *Tamil Nadu Journal of*

- Veterinary and Animal Sciences. 2011; 7(2):60-63.
32. Thiruvankadan AK, Panneerselvam S, Kandasamy N. Reproductive performance of Kanni Adu goats under field conditions. Indian Journal of Animal Sciences. 2000a; 70(7):691-693.
  33. Thiruvankadan AK, Panneerselvam S. Kandasamy N. Distribution, characteristics and production performance of Kanni adu goats of Tamil Nadu Tamil Nadu Journal of Veterinary and Animal Sciences. 2000b; 70(7):723-727.
  34. Thiruvankadan AK, Karunanirhi K. Characterisation of Salem Black goats in their home tract. Animal Genetic Resources Information. 2006; 38:67-75.
  35. Thiruvankadan AK, Muralidharan J, Karunanithi K. Body weight changes during different physiological stages of Mecheri ewes. Indian Journal of Animal Sciences. 2008; 78(12):1389-1392.
  36. Thiruvankadan AK. Kodi Adu goat - A Monograph. Tamil Nadu Veterinary and Animal Sciences University, Chennai-51, Tamil Nadu, 2012.