EFFECT OF MANAGEMENT SYSTEM ON NUTRIENT INTAKE AND SEMINAL ATTRIBUTES IN JAMUNAPARI BUCKS

Natesan Ramachandran¹*, Narendra Pal Singh¹, Ajaykumar Shinde¹, Ramkesh Meena² and Anil Kumar Goel¹

¹ICAR-Central Institute for Research on Goats, Makhdoom, Farah Uttar Pradesh 281122 India
²CSWRI, Avikanagar, Rajasthan 304 501, India

Received – August 22, 2016; Revision – September 21, 2016; Accepted – October 04, 2016
Available Online – October 13, 2016
DOI: http://dx.doi.org/10.18006/2016.4(Spl-2-SSPN).S23.S28

ABSTRACT

The present study assessed comparative semen production potential of Jamunapari bucks under stall feeding (SF) and grazing cum supplementation (GS) systems of 10 animals in each system under group feeding and management conditions. SF Bucks received 500 g concentrate pellets and 700 g green fodder/h/d besides ad lib dry fodder for continuous one year. GS Bucks were allowed 4-6 hr daily grazing and supplemented concentrate pellets @ 500 g/h/d. Intake of nutrients by bucks in two groups were calculated, semen were collected using AV method biweekly to assess seminal traits. The apparent digestibility coefficients of dry matter, crude protein and hemi cellulose were higher in feed materials consumed by GS bucks than SF bucks. However, neutral detergent fibre, acid detergent fibre and cellulose digestibility had shown a reverse trend. The overall Least Square Mean (LSM) for intake of DM, OM, CP, NDF, ADF, hemicellulose, cellulose, ME install-fed bucks were 1309.38, 1190.62, 176.99, 728.72, 410.08, 306.11, 266.09 g/day, 7.76 MJ/d, respectively. The respective nutrients intake in GS bucks were 1396.14, 1259.67, 198.87, 685.24, 367.99, 335.99, 211.23 g/day, 8.21MJ/d. LSM for volume (ml), color (1-2 scale), consistency (1-4 scale), mass activity (0-5 scale), initial progressive motility (%), sperm density(10⁶/ml), live sperms (%) and abnormal sperms (%) of semen produced by SF bucks were 0.92, 1.19, 2.86, 4.30, 78.21, 4317.41, 82.96, and 1.77, respectively. The respective values for the semen of GS bucks were 0.69, 1.24, 2.67, 3.64, 72.78, 3183.14, 74.87 and 2.18. Analysis of data revealed that SF bucks performed better (P<0.01) with lower nutrients intake than the GS bucks.

* Corresponding author (All authors contributed equally)
E-mail: ramacirg@gmail.com (Natesan Ramachandran)

Peer review under responsibility of Journal of Experimental Biology and Agricultural Sciences.

All the article published by Journal of Experimental Biology and Agricultural Sciences is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License Based on a work at www.jebas.org.
1 Introduction

Goats are reared under extensive, semi-intensive and intensive systems of management. They are widely adapted and reproduce efficiently in different climatic conditions. The production performance varies and widely depending upon inputs available under different production systems. Reproduction is a complex physiological process involving entire animal body to achieve its function of production of young ones. Several studies have documented interrelationship between nutrient intake and reproductive performance in adult males (Singh & Sengar, 1990; Walkden-Brown et al., 1994; Dana et al., 2000; Fernandez et al., 2004; Mohamed & Abdelatif, 2010). Studies on the effect of nutrition on quantity and quality of semen produced by goat bucks were limited (Mekasha et al., 2007; Mellado et al., 2012). Although literature pertaining to semen production potential of breeding bucks under particular system of management is widely available, studies on the performance under different management system are scanty (Hannamte et al., 2009). Therefore, the present study was aimed to determine effect of two management systems on nutrient intake and seminal traits in adult Jamunapari bucks.

2 Materials and Methods

The present study was conducted at ICAR-Central Institute for Research on Goats (CIRG), Mahdooom, Farah, Mathura. The mean monthly weather parameters that were recorded during experiment were maximum (22.44 - 41.21°C) and minimum (4.18 - 26.16°C) temperature, relative humidity (30.43 - 74.59 %), vapor pressure (8.15 - 25.43 mmHg) and cumulative rainfall (0 - 132.4 mm) as well as duration of sun shine (168.70 - 306.9 hrs).

2.1 Experimental animals and their management

Twenty Jamunapari bucks of almost similar age (659.25±2.79 days) and body weight (29.55±0.67 kg) stationed at institute’s experimental farm were randomly selected. Ten animals were allotted each to stall feeding (SF) and grazing cum supplementation (GS) systems under group feeding and management conditions. Bucks were managed and fed in two separate groups uniformly. Bucks under SF system were offered 500 g/h/d pelleted concentrate mixture and 700 g/h/d green fodder besides available dry fodder ad libitum. Concentrate pellets comprised of Barley (10%), Deoiled rice polish (20%), Til/groundnut cake (expeller) (40%), wheat bran (20%), molasses (7%), mineral mixture (2%) and salt (1%). Green fodders viz. berseem, cowpea, oats, barley, and dry fodders viz. gram, arhar, wheat, or barley straws were used for feeding the SF bucks. Bucks under GS group were allowed for 4 to 6 hours daily grazing in the institute grazing area and supplemented with concentrate pellets @ 500 g/h/d. The grazing material available to animals of GS group varied according to seasons. Clean drinking water was made available round the clock in open paddocks for both groups.

2.2 Estimation of nutrient intake

The feed and forage samples were collected from grazing area and feeding troughs. Faecal samples were collected from twelve (6 each) randomly selected bucks using faecal bags for half an hour in the morning and evening. All these samples were collected for five consecutive days on 6th to 10th day of chromium oxide feeding in mid of each season, dried in an oven at 60 to 70°C for 24 hours, stored in plastic bags and proximate composition was carried out subsequently. The AOAC (1999) analytical procedures were used for organic matter (OM) determination by ash at 550°C for 4 hour; nitrogen (N) estimation by Kjeldahl technique; total lipids were estimated using solvent extraction procedure by soxhlet apparatus. Neutral Detergent Fibre (NDF) and Acid Detergent Fibre (ADF) were determined by sequential procedure using same sample (Robertson & Van Soest, 1981; Van Soest et al., 1991).

The forage intake of GS bucks from grazing area was estimated using lignin ratio technique (Shinde et al., 2000; Singh et al., 2004). The total dry matter intake of bucks from both groups was calculated through total quantity of feed consumed daily on dry matter basis. The intake of different nutrients was calculated by deducting out go of nutrients in faeces from total daily intake of that particular nutrient after proximate analysis of feeds, forages and faecal samples. The total faecal output of experimental bucks was estimated using Chromium Oxide Paper Capsule Indicator Method (Shinde et al., 2000). The metabolizable energy (ME) intake was calculated as per ARC standard

$$MEI = OMI\times g \times 19 \times 0.82.$$

2.3 Semen collection and Evaluation

The semen from all breeding bucks of both groups was collected using Artificial Vagina (AV) method twice a week after giving one false mount and a single collection was taken from each buck. Quantitative seminal traits viz. volume, sperm density per ml and qualitative traits viz. colour, consistency, mass activity, progressive motility, live sperms count and total abnormal sperms count were estimated as per semen analysis procedure.

2.4 Statistical analysis

The data generated on nutrient intake, semen quantity and quality were analyzed using least squares means and analysis of variance (Harvey, 1990). Arc sine transformation was carried out for per cent values viz. sperm motility, live sperms count etc and logarithmic transformation was done for sperm concentration before analysis of the data for finding significance between groups.
Results and Discussion

3.1 Impact on Nutrients

The average dry matter (DM), organic matter (OM), crude protein (CP), Neutral Detergent Fibre (NDF), Acid Detergent Fibre (ADF), hemicellulose and cellulose digestibility of feed and forages consumed by SF bucks were observed to be 58.18%, 61.37%, 60.46%, 36.32%, 69.35% and 45.43%, respectively. The respective digestibility of nutrients for GS bucks was 60.43%, 62.84%, 63.07%, 48.69%, 26.88%, 74.94% and 41.45% (Table 1). Perusal of table indicated that digestibility of nutrients consumed by the GS bucks was significantly higher than SF bucks except for organic matter.

The intake of DM, OM, CP and metabolizable energy (ME) in Jamunapari bucks under GS system (1396.14, 1259.67, 198.87 g/d and 8.21 MJ/d) were significantly higher than bucks under SF system (1309.38, 1190.62, 176.99 g/d and 7.76 MJ/d). However, intake of fibre fractions of diet viz., NDF, ADF, cellulose was significantly higher in bucks under stall feeding than GS system. The information on nutrient intakes of breeding males is meager. The digestibility coefficients of nutrients consumed by Jamunapari bucks in the present study corroborate with findings of Raghuvansi et al. (2007) in adult rams under different management systems. Significantly higher DM, CP and ME intakes of GS bucks as compared to the bucks under SF system could be due to consumption of wide range of grazing materials in addition to supplementation. However, Raghuvansi et al. (2007) reported significantly higher (P<0.01) DM, OM, CP and ME intake in stall fed lambs than semi-intensively reared lambs. The lower nutrient intake in kids (Dutta & Singh, 2009) and young bucks (Mekasha et al., 2007; Mekasha et al., 2008) under intensive rearing system and adult bucks (Tripathi et al., 2007) under extensive rearing system have also been reported. However, Raghuvansi et al. (2007), reported higher ME intake (8.92-12.35 MJ/d) in rams under intensive rearing system than the present study. Similarly, the digestible energy (GE) intake of the young Ogaden bucks of Ethiopia was reported as 5.1 to 8.5 MJ/kg DM under intensive rearing system (Mekasha et al., 2007). Differences in nutrient intake could be attributed to variation in availability and type of feed and its quality, grazing behavior, system of rearing and age of experimental animals etc.

3.2 Impact on seminal traits

The least squares means and analysis of variance for seminal traits were presented in Table 2. The volume, color, consistency, mass activity, initial progressive motility, sperm density, live sperms and abnormal sperms of semen of SF bucks were recorded to be 0.92 ml, 2.86 (1-4 scale), 4.30 (0-5 scale), 78.21 %, 4317.41 millions/ml, 82.96 % and 1.77 %, respectively which were significantly higher (P<0.01) than those reared under GS system (0.69, 2.67, 3.64, 72.78, 3183, 74.87 and 2.18).

Table 1 Least squares means and analysis of variance for nutrient digestibility and nutrient intake of Jamunapari bucks reared under different management systems

| Attributes                          | Stall feeding | Grazing plus supplementation | Significance level |
|-------------------------------------|---------------|-------------------------------|--------------------|
| Nutrient digestibility coefficients (%) |               |                               |                    |
| Dry matter                          | 58.18 ± 0.54  | 60.43 ± 0.54                  | **                 |
| Organic matter                      | 61.37±0.52    | 62.84±0.52                    | NS                 |
| Crude protein                       | 60.46±0.66    | 63.07±0.66                    | **                 |
| Neutral detergent fibre             | 51.60±0.98    | 48.69±0.98                    | *                  |
| Acid detergent fibre                | 36.32±1.13    | 26.88±1.13                    | **                 |
| Hemicellulose                       | 69.35±1.35    | 74.94±1.35                    | **                 |
| Cellulose                           | 45.43±1.25    | 41.45±1.25                    | *                  |
| Nutrient Intake (g/day)             |               |                               |                    |
| Dry matter                          | 1309.38 ± 21.74 | 1396.14 ± 21.74                  | **                 |
| Organic matter                      | 1190.62±19.66 | 1259.67±19.66                  | *                  |
| Crude protein                       | 176.99±3.02   | 198.87±3.02                    | **                 |
| Neutral detergent fibre             | 728.72±11.63  | 685.24±11.63                   | *                  |
| Acid detergent fibre                | 410.08±6.39   | 367.99±6.39                    | **                 |
| Hemicellulose                       | 306.11±5.49   | 335.99±5.49                    | **                 |
| Cellulose                           | 266.09±3.91   | 211.23±3.91                    | **                 |
| Metabolizable Energy (MJ/d)         | 7.76±0.13     | 8.21±0.13                      | *                  |

**P<0.01 * P<0.05 NS- Non-Significant
Table 2 Least squares means and analysis of variance for seminal parameters of Jamunapari bucks reared under different management systems

| Seminal parameters | Stall feeding | Grazing plus supplementation | Significance level |
|--------------------|---------------|------------------------------|-------------------|
| Volume (ml)        | 0.92 ± 0.02   | 0.69 ± 0.02                  | **                |
| Color (1-2 scale)  | 1.19 ± 0.02   | 1.24 ± 0.02                  | NS                |
| Consistency (1-4 scale) | 2.86 ± 0.03   | 2.67 ± 0.04                  | **                |
| Mass activity (0-5 scale), | 4.30 ± 0.07   | 3.64 ± 0.07                  | **                |
| Initial progressive motility (%) | 78.21 ± 0.01   | 72.78 ± 0.01                  | **                |
| Sperm concentration (10⁹/ml) | 4317.41 ± 1.03 | 3183.14 ± 1.03                | **                |
| Live sperms (%)   | 82.96 ± 0.01  | 74.87 ± 0.01                  | **                |
| Abnormal sperms (%) | 1.77 ± 0.001 | 2.18 ± 0.001                  | **                |

** P<0.01 NS- Non-Significant

The semen production potential of bucks varies with age, breed, season, nutrient intake, rearing systems, semen collection methods. No abnormality of color in any of 660 samples observed in current study indicated that semen collection procedure was proper. The significantly (P<0.01) higher semen quantity as well as quality of SF bucks as compared to GS bucks in the present study indicated the availability of more nutrients for production in SF bucks. However, Fourie et al. (2004) in young Dorper rams and Hammante et al. (2009) in Osmanabadi bucks reported superior semen quality under extensive and semi-intensive rearing systems, respectively as compared to stall-fed system. The lower (Srinivas et al., 2002; Sundaraman & Edwin, 2003; Naing et al., 2011) and higher seminal parameters under intensive (Kulaksiz & Daskin, 2010; Salviano et al., 2012; Fonseca et al., 2013; Qureshi et al., 2013; Ahmad et al., 2014) and semi-intensive (Thukur et al., 2005; Hassan et al., 2010) rearing systems have also been reported. The variation in semen quality parameters under different rearing systems in the present study could be due to variation in nutrient availability for semen production, breed and age of bucks which corroborates earlier findings (Mekasha et al., 2007; Bucak & Uysal, 2008; Mohamed & Abdelatif, 2010; Naing et al., 2011; Mellado et al., 2012; Ramachandran et al., 2015).

The LSM for abnormal sperms of semen produced by GS bucks was significantly (P<0.01) higher than SF bucks (2.18 vs 1.77%) which was lower than report of Naing et al. (2011) in Boer bucks. Dorado et al. (2010) also recorded higher mean abnormal sperms (18.52 to 35.40 %) in Florida bucks. Contrary to this research findings, Fourie et al. (2004) reported significantly higher overall abnormal sperms in young Dorper rams reared under intensive system than those under extensive system (12.1 vs 17.2%). The abnormal sperms recorded in the present study were much lower than previous reports under different management systems. This may be attributed to better feeding management of bucks. The higher overall sperm abnormality of GS bucks in the present study could be due to higher energy expenditure during grazing. This could lead to low nutrient availability towards supply of nutrients required for sperm production, although energy and protein intakes were significantly higher in GS bucks. Further, significantly lower sperm abnormality (1 to 2%) observed in the present study vis à vis the results of all previous reports could mainly be due to the variation in data transformation apart from variation arising out of genetic and non-genetic factors like breed, age and semen collection, processing and evaluation procedures.

Conclusion

The present study indicated that the nutrients intake in terms of dry matter, crude protein and metabolizable energy was significantly higher in bucks under grazing plus supplementation system than that of bucks under stall feeding system. The seminal traits of stall fed bucks were superior to GS bucks, though; all the seminal traits studied were within the range required for fertility under both management systems round the year. Therefore, it could be inferred that stallfed bucks can perform better with lower level of nutrients intake than GS bucks under studied level of nutrients intake and feeding system.

Acknowledgement

Authors are thankful to the Director, CIRG, Mahdoom and Head PR & SM Division for providing all necessary facilities to conduct this experiment. The sincere technical help rendered by Shri Dori Lal Gupta and Shri Hari Om, Technical Officers for this study is also thankfully acknowledged.

Conflict of interest

Authors would hereby like to declare that there is no conflict of interests that could possibly arise.

References

Ahmad M, Nasrullah R, Riaz H, Sattar A, Ahmad N (2014) Changes in motility, morphology, plasma membrane and acrosome integrity during stages of cryopreservation of buck sperm. Journal of the South African Veterinary Association 85: 4 pages. http://dx.doi.org/10.4102/jsava.v8i1.972.
AOAC (1999). *Official Methods of Analysis*, 15th edn. Association of Official Analytical Chemist, Washington, DC, USA.

Bucak MN, Uysal O (2008). The role of antioxidants in freezing of Saanen goat semen. Indian Veterinary Journal 85: 148-150.

Dana N, Tegegna A, Shenkoru T (2000) Feed intake, sperm output and seminal characteristics of Ethiopian highland sheep supplemented with different levels of leucaena (*Leucaena leucocephala*) leaf hay. Animal Feed Science and Technology 86: 239-249. DOI: http://dx.doi.org/10.1016/S0377-8401(00)00152-8.

Dorado J, Munoz-Serrano A, Hidalgo M (2010) The effect of cryopreservation on goat semen characteristics related to sperm freezability. Animal Reproduction Science 121: 115-123. http://dx.doi.org/10.1016/j.anireprosci.2010.04.182.

Dutta TK, Singh NP (2009) Voluntary feed intake, growth, rumen fermentation and nutrient utilization in different breeds of Indian goats reared under intensive system. The Indian Journal of Animal Science 79: 311-315.

Fernandez M, Giraldez FJ, Frutos P, Lavin P, Mantecon AR (2004) Effect of undegradable protein supply on testicular size, spermogram parameters and sexual behaviour of mature Assaf rams. Theriogenology 62: 299-310. DOI: http://dx.doi.org/10.1016/j.theriogenology.2003.10.003.

Fourie PJ, Schwalbach LM, Neser FWC, Van der Westhuizen C (2004) Scrotal, testicular and semen characteristics of young Dorper rams managed under intensive and extensive conditions. Small Ruminant Research 54: 53-59. DOI: http://dx.doi.org/10.1016/j.smallrumres.2003.10.011.

Fonseca VFC, Saraiva EP, Filho ECP, MaiorJR RJS, Pereira WE, Silva AL, Gomes DLS, Moura JHA (2013) Sexual behavior and physical aspects of the semen of Moxoto breed goats at different ages. Semina: CiênciasAgrarias, Londrina. 34: 895-904.

Hamante AA, Barbinder RP, Mule RS, Baswade SV, Andhare BC (2009) Effect of management system on semen quality attributes of Osmanabadi bucks. The Indian Journal of Small Ruminants 15: 115-117.

Hassan MR, Talukder MAI, Sultana S (2010) Evaluation of the production characteristics of the Jamunapari goat and its adaptability to farm conditions in Bangladesh. Bangladesh Veterinarian 27: 26-35. DOI: http://dx.doi.org/10.3329/bvet.v27i1.5912.

Harvey (1990) Users guide for LSML. MW and MIXMDL PC-2 Version Mixed model least square and maximum likelihood computer program. Ohio State University, Columbus.

Kulaksiz R, Daskin A (2010) In vitro evaluation of Saanen buck semen frozen in different extenders supplemented with various antioxidants. Ankara University Faculty of Veterinary Medicine Journal 57: 151-156.

Mekasha Y, Tegegne A, Rodriguez-Martinez H (2007) Effect of supplementation with agro-industrial by-products and khat (*Catha edulis*) leftovers on testicular growth and sperm production in Ogaden bucks. Journal of Veterinary Medicine Series A 54: 147-155. DOI: 10.1111/j.1439-0442.2007.00876.x.

Mekasha Y, Tegegne A, Rodriguez-Martinez H (2008) Feed intake and sperm morphology in Ogaden bucks supplemented with either agro-industrial by-products or Khat (*Catha edulis*) left over. Reproduction in Domestic Animals 43: 437-444. DOI: 10.1111/j.1439-0531.2007.00931.x.

Mellado M, Herrera CAM, Arevalo JR, Garcia JE, Veliz FG (2012) Effect of dietary energy intake and somatotropin administration after weaning on growth rate and semen characteristics of Granadina goat bucks. Turkish Journal of Veterinary and Animal Sciences 36: 338-45.

Mohamed SA, Abdelatif AM (2010) Effect of level of feeding and season on thermoregulation and semen characteristics in desert rams (Ovisaries). Global Veterinaria 4: 207-215.

Naing SW, Haron AW, Goriman MAK, Yusoff R, Bakar MZA, Sarsaifi K, Bukar MM, Thein M, KyawT, Sun MM (2011) Effect of seminal plasma removal, washing solutions and centrifugation regimes on Boer goat semen cryopreservation. Pertanika Journal of Tropical Agricultural Science 34: 271-79.

Qureshi MS, Khan D, Mushtaq A, Afridi SS (2013) Effect of extenders, post dilution intervals and seasons on semen quality in dairy goats. Turkish Journal of Veterinary and Animal Sciences 37: 147-52. doi:10.3906/vet-1110-24.

Raghuvansi SKS, Tripathi MK, Mishra AS, Chaturvedi OH, Prasad R, Saraswat BL, Jakhmola RC (2007) Feed digestion, rumen fermentation and blood biochemical constituents in Malpura rams fed a complete feed-block diet with the inclusion of tree leaves. Small Ruminant Research 71: 21-30. DOI: http://dx.doi.org/10.1016/j.smallrumres.2006.03.012.

Ramachandran N, Yadav S, Sikarwar AKS, Saraswat S, Ranjan R, Jindal SK (2015) Effect of equilibration periods on post-thaw semen quality of Jamunapari bucks. The Indian Journal of Small Ruminants 21: 234-237.

Robertson JB, Van Soest PJ (1981) The detergent system of analysis and its application to human foods. Cornell University, Ithaca, New York, NY, USA.

Salviano MB, Vidigal KF, Moraes Junior FJ, Sousa Junior A, Cavalcante TV, Salviano LMC, Souza JAT (2012) How the
scrotal conformation can influence the semen quality in goats? Journal of Veterinary Advances 2: 240-247.

Shinde AK, Bhatta R, Sankhyan SK (2000) Research techniques in grazing studies. CSWRI bulletin, Avikanagar, Rajasthan, India. pp 1-101.

Singh NP, Sankhyan SK, Shinde AK (2004) Animal nutrition and feed resources development research. CSWRI bulletin, Avikanagar, Rajasthan, India. pp.1-61.

Singh SN, Sengar OPS (1990) Studies on the combining ability of desirable characters of important goat breeds. Final Technical Report, PL-480 Research project, RBS College, Bichpuri (Agra), Uttar Pradesh, India. pp1-446.

Srinivasa M, Naidu KV, Chetty AV (2002) Seasonal variation in physical characteristics of native buck (Capra hircus) semen in Andhra Pradesh. Indian Journal of Animal Reproduction 23: 184-86.

Sundararaman MN, Edwin MJ (2008) Changes in motility characteristics of goat spermatozoa during glycerol equilibration and the relevance to cryopreservation. Asian Journal of Cell Biology 3: 22-33.

Thakur YP, Singh M, Jasial S (2005) Semen production and freezability attributes of Chegu Pashmina bucks. Indian Journal of Animal Science 75 : 1165-1167.

Tripathi P, Dutta TK, Upadhyaya RS, Gupta DL (2007) Evaluation of various rainfed pastures for goat production in Yamuna ravines of Uttar Pradesh. Range Management and Agroforestry 28: 358-359.

Van Soest PJ, Robertson JB, Lewis BA (1991) Methods for dietary fiber, neutral detergent fiber and non-starch polysaccharides in relation to animal nutrition. Symposium: Carbohydrate methodology, metabolism and nutritional implications in dairy cattle. Journal of Dairy Science 74: 3583-3597. DOI: http://dx.doi.org/10.3168/jds.S0022-0302(91)78551-2.

Walkden-Brown SW, Restall BJ, Taylor WA (1994) Testicular and epididymal sperm content in grazing Cashmere bucks: seasonal variation and prediction from measurements in-vivo. Reproduction, Fertility and Development 6:727-736.