



Assessment of rearing systems and seasons on nutrient intake and semen freezability in Jamunapari bucks

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Received: 12 January 2016; Accepted: 1 May 2016

ABSTRACT

The present study assessed the semen freezability of Jamunapari bucks reared under 23 rearing systems for 3 consecutive seasons. Bucks (20) were randomly allotted equally to stall feeding (SF) and grazing plus supplementation (GS) systems. Lignin ratio technique was used for nutrients intake determination and indirect indicator method for estimation of total faecal output. Proximate analysis of feeds, forages and faecal samples was done. Semen was collected using artificial vagina twice a week, evaluated and diluted by 2 step method using Tris-egg yolk-citrate-fructose-glycerol diluents having 10% (v/v) egg yolk and 6% (v/v) glycerol. The samples were frozen as per protocol developed at this Institute. The data were analyzed by standard statistical method. The overall dry matter intake, digestible crude protein intake and metabolizable energy intake of GS bucks were significantly higher than the SF bucks. The bucks consumed significantly higher nutrients in winter followed by summer and rainy season. The initial progressive motility varied significantly between rearing systems and among seasons. The overall pre-freeze and post-thaw progressive motility was similar between rearing systems and seasons. Post-thaw progressive motility was significantly lower in summer than the other seasons studied.

Key words: Jamunapari bucks, Rearing systems, Seasons, Semen freezability

India is home to 135.17 million goats (19th Livestock Census, India) with 24 recognized breeds developed in different agro-climatic regions to cater the multi-facet needs of people of the country. Jamunapari is one of the largest size and widely known for high milk production among goat breeds in India (Accession number: INDIA_GOAT_2000_Jamunapari_06011). This breed is extensively used for up-gradation of local goats in India and in many South Asian countries. However, population and productivity of Jamunapari goats are declining and deteriorating mainly due to indiscriminate breeding on account of extreme scarcity of quality and pure-bred bucks. Therefore, these goats have become endangered with a very small population of less than 3,000 in its habitat. Jamunapari goats are reared mainly by poor goat keepers in small flock (2–5) on degraded community grazing resources without pure-bred breeding buck. The system of goat rearing is now shifting from traditional extensive system to semi-intensive and intensive system. The production performance of bucks varies widely among rearing systems and the males produced under a particular system may not suit that well under the other systems. Therefore, the evaluation of semen production potential of bucks for semen freezing as an *ex situ* conservation measure for genetic improvement is essentially required.

The quantitative and qualitative semen production

potential of males varies widely with age, breeds, nutrients intake under different rearing systems and seasons, semen collection methods etc. There is a wealth of information on the reproductive performance of bucks in different goat breeds under different rearing systems (Hassan *et al.* 2010, Qureshi *et al.* 2013), seasons (Aguiar *et al.* 2013). The effect of different nutrients intake level on initial semen quality is widely available in the literature (Coulter *et al.* 1997, Mellado *et al.* 2012, Selvaraju *et al.* 2012). In Ossimi rams, increasing maintenance energy intake by 1.7 times resulted in higher semen freezability (68.35%) as compared to 1.2 times (Ei-Hommosi 1982). The information pertaining to its effect on semen freezability is limited or not available. Therefore, the present study was aimed to determine the effect of nutrients intake under different rearing systems and seasons on semen freezability in adult Jamunapari bucks.

MATERIALS AND METHODS

Location and climate: The present study was carried out at this Institute, which is located at latitude 27.10° north, longitude 77.9° east and altitude 163.4 m above the mean sea level. The temperature ranges between –2.5° and 50°C under extreme conditions and the climate is almost semi-arid type. The mean monthly maximum and minimum temperature, relative humidity, vapour pressure and cumulative rainfall as well as duration of sunshine during the experiment ranged from 22.44–41.21°C, 4.18–26.16°C,

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30.43–74.59%, 8.15–25.43 mm Hg, 0–132.4 mm, 168.7–306.99 h, respectively.

Experimental animals, feeding and general management: Jamunapari bucks (20) were randomly and equally allotted to stall feeding (SF; 10) and grazing cum supplementation (GS; 10) systems and managed in 2 separate groups having a covered area of 45 m² and open area of 86 m² at Institute's experimental farm. The bucks under SF system were offered 500 g/h/d concentrate pellets, 700 g/h/d green fodder and *ad lib.* dry fodder while bucks under GS group were allowed for 4–6 h daily grazing in the Institute grazing area and supplemented with 500 g/h/d concentrate pellets. The concentrate pellets comprised 10% barley, 20% deoiled rice polish, 40% til/groundnut expeller cake, 20% wheat bran, 7% molasses, 2% mineral mixture and 1% salt. Clean drinking water was made available round the clock in the open paddock. Green fodders, viz. berseem, cowpea, oats, barley, and the dry fodders, viz. gram, arhar, wheat, or barley straws were used for feeding the SF bucks. The grazing material available to the animals of the GS group varied according to the season. The routine prophylactic measures (deworming and vaccination) and recommended housing management practices were undertaken during the trial continuously for 1 year covering 3 seasons, viz. rainy (July-Oct), winter (Nov-Feb) and summer (Mar-June).

Sample collection and estimation of nutrient intake: The feed and forage samples were collected from the grazing area and feeding troughs. The faecal samples were collected from 12 (6 each) randomly selected bucks using faecal bags for half an hour in the morning and evening. All the samples were collected for 5 consecutive days on 6th–10th day after chromium oxide feeding was done in mid of each season. Samples were dried in an oven at 70°C for 24 h, stored in plastic bags and later assessed for proximate composition (AOAC 1999). The forage intake of the GS bucks from grazing area was estimated using lignin ratio technique (Shinde *et al.* 2000) and the total dry matter intake of bucks of both groups was calculated from the total quantity of feed consumed daily on dry matter basis. The intake of different nutrients was calculated by deducting the outgo of nutrients in faeces from the total daily intake of that particular nutrient after proximate analysis of feeds, forages and faecal samples. The total faecal output of the experimental bucks was estimated using chromium oxide paper capsule indicator method (Shinde *et al.* 2000). The metabolizable energy intake (MEI) was calculated as per ARC standard.

Semen freezing and evaluation: The semen was collected after 8 weeks of trial using artificial vagina (AV) twice a week. Semen sample was evaluated and those having volume ≥ 0.5 ml and free of coagulation, wave motion >3.5 , $>70\%$ initial progressive motility (IPM) were used for freezing. The qualified samples were diluted with Tris-egg yolk-citrate-fructose-glycerol (TEYCFG) extender (Tris- 0.29 M; citric acid- 0.1 M; fructose- 0.11 M; egg yolk- 10%; glycerol-6%; streptomycin-100 mg; penicillin-

100,000 IU; triple distilled water-100 ml; pH- 6.75–6.8) using a 2-step dilution method (Deka and Rao 1986). The samples were equilibrated at 5°C for 4 h and vapour frozen 2 cm above the surface of liquid nitrogen for 10 min. They were subsequently plunged into liquid nitrogen at –196°C, where they were stored for 24–48 h.

Statistical analysis: The data were subjected to least squares means (LSM) and analysis of variance (ANOVA) by Harvey method after arcsine transformation to assess the effect of rearing systems and seasons on nutrient intake and seminal parameters. The significant mean differences among seasons were also compared by critical difference test.

RESULTS AND DISCUSSION

The effects of 2 rearing systems during 3 consecutive seasons on nutrient intake and sperm parameters were assessed in breeding bucks. There were differences in dry matter intake (DMI), metabolizable energy intake (MEI) and digestible crude protein intake (DCPI) of bucks under different rearing systems and seasons (Table 1).

The overall DMI, DCPI and MEI of GS bucks were significantly higher ($P<0.01$) than the SF bucks (Table 1). The bucks consumed significantly higher ($P<0.01$) nutrients in winter followed by summer and rainy season. Semen production appeared to be responsive to improved nutrition at all times of the year and nutritional effects were closely associated with changes in hormone concentration

Table 1. Least squares means for dry matter, energy and protein intakes in Jamunapari bucks

Nutrients intake	Groups	Seasons			Overall
		Rainy	Winter	Summer	
DMI (g/day)	SF	1266.43±19.67	1347.62±35.93	1314.08±52.00	1309.38±21.74 ^B
	GS	1277.54±30.10	1513.99±46.32	1396.88±32.71	1396.14±21.74 ^A
	Overall	1271.99±26.62 ^c	1430.81±26.62 ^a	1355.48±26.62 ^b	1352.76±15.37
MEI (MJ/d)	SF	7.52±0.12	8.02±0.14	7.74±0.33	7.76±0.13 ^{B*}
	GS	7.35±0.17	8.88±0.27	8.40±0.20	8.21±0.13 ^{A*}
	Overall	7.44±0.16 ^c	8.45±0.16 ^a	8.07±0.16 ^b	7.99±0.09
DCP (g/day)	SF	105.00±1.06	102.71±2.55	112.93±3.98	106.88±2.13 ^B
	GS	108.75±1.92	136.31±4.50	131.91±5.43	125.65±2.13 ^A
	Overall	106.87±2.61 ^c	119.51±2.61 ^b	122.42±2.61 ^a	116.27±1.51

SF, stall feeding; GS, grazing plus supplementation; DMI, dry matter intake; MEI, metabolizable energy intake; DCPI, digestible crude protein intake. Different superscripts (A,B) within the same column for same parameter are significantly different ($P<0.01$; * $P<0.05$). Different superscripts (a,b,c) within the same row for same parameter are significantly different ($P<0.01$).

(Walkden-Brown and Bocquier 2000). A wide range of goat rearing systems associated with climatic, traditional, social and economical constraints influence the variation in reproductive capacity of the goats in addition to the large number of genetically distinct breeds of India.

The mean dry matter, energy and protein intakes of GS bucks were significantly higher ($P < 0.05$) than SF bucks. This may be due to the consumption of wide range of grazing materials available in the field in addition to the supplementation. These data corroborated with results of Raghuvansi *et al.* (2007). However, lower nutrient intake in young bucks (Mekasha *et al.* 2007) under intensive rearing system and adult bucks (Tripathi *et al.* 2007) under extensive rearing system were also reported. Differences in nutrient intake could be attributed to the variation in the availability and type of feed and its quality in each season, grazing behaviour of the species, systems of rearing and age of the experimental animals etc. The high nutrients consumption by the bucks during winter might be attributed to availability of high quality fodders in both rearing systems. The availability of fully grown biomass in the grazing field for the GS bucks during winter season as it is followed by the rainy season. The overall progressive sperm motility at initial, pre-freeze and post-thaw stages irrespective of rearing systems and seasons were 75.54, 72.05 and 24.87%, respectively. The overall initial progressive sperm motility (IPM) varied significantly ($P < 0.01$) between rearing systems and among seasons (Table 2; Fig. 1).

There was no significant difference ($P < 0.05$) in overall PFPM and PTPM between rearing systems. However, the PTPM was significantly lower ($P < 0.05$) in summer than rainy season and winter. The IPM, PFPM and PTPM of SF buck semen was significantly higher ($P < 0.01$) in rainy season than winter and summer. However, the IPM of GS buck semen was significantly higher ($P < 0.01$) in summer followed by rainy and winter seasons. Though the PFPM of GS buck semen was higher ($P < 0.01$) in rainy season, the PTPM no significant difference was observed in ($P < 0.05$) in all 3 seasons studied.

The quantity and quality of semen may vary due to breed, age, season, nutritional level and semen collection procedures. The quality of diluted and frozen semen depends on semen processing methods and its evaluation. The mean IPM (75.54%) in the present study corroborates the previous

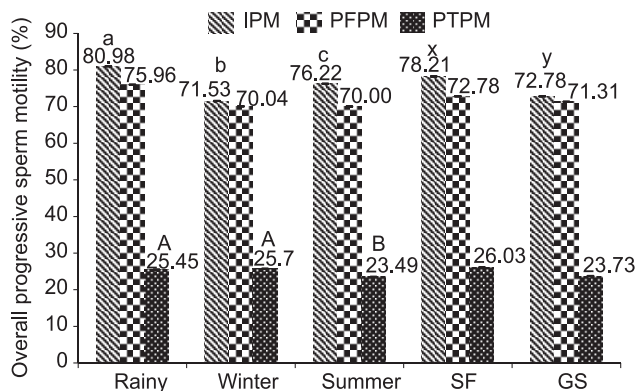


Fig. 1. Overall progressive sperm motility under different rearing systems and seasons in Jamunapari bucks. Different superscripts (a, b and c) for same parameter among seasons are significantly different ($P < 0.01$). Different superscripts (A and B) for same parameter among seasons are significantly different ($P < 0.05$). Different superscripts (x and y) for same parameter between rearing systems are significantly different ($P < 0.01$).

findings of our laboratory (Ranjan *et al.* 2009, 2015). The higher mean IPM in semen of SF bucks could mainly be due to higher nutritional status even though the nutrient intake is lower than the GS bucks. The availability of nutrients for semen production may be lower for the GS bucks due to nutrient loss that occurs in long travel in the grazing area for search of grazing material. However, there was higher mean IPM in Marwari bucks under semi-intensive rearing system (84.37%) than that under intensive system (Ranjan *et al.* 2009). The sperm motility in the present study coincides with previous reports for intensive (Sundaraman and Edwin 2003, Kulaksiz *et al.* 2013) and semi-intensive (Gangwar *et al.* 2014) rearing systems.

The PFPM, which is 2–6% lower than IPM in the present study, indicated that the equilibration of 4 h adopted in our freezing protocol is optimum to protect sperms from cryoinjury. The PFPM is comparable and PTPM is lower than the earlier reports in intensively reared bucks (Ranjan *et al.* 2009). The mean post-thaw motility during breeding and non-breeding season ranged from 42.9 to 51.7% and from 27.7 to 38.0%, respectively, in intensively reared Saanen bucks (Ustuner *et al.* 2009). Under semi-intensive rearing system, the mean post-thaw motility during rainy season was 53.43% in Chegu bucks (Thakur *et al.* 2005). However, slightly lower mean post-thaw motility than the present study was also observed in intensively managed

Table 2. Least squares means for pre-freeze and post-thaw progressive motility (%) of Jamunapari buck semen

Seasons/ Groups	Initial-progressive motility (IPM%)		Pre-freeze progressive motility (PFPM%)		Post-thaw progressive motility (PTPM%)	
	SF	GS	SF	GS	SF	GS
Rainy	83.48 ^a ± 0.01 (137)	75.18 ^a ± 0.02 (116)	77.15 ^a ± 0.01 (86)	74.75 ^a ± 0.02 (42)	27.10 ^a ± 0.02 (86)	23.83± 0.04 (42)
Winter	74.30 ^b ± 0.02 (104)	67.72 ^b ± 0.02 (91)	71.35 ^{bA} ± 0.01 (69)	68.72 ^b ± 0.02 (41)	27.62 ^a ± 0.03 (69)	23.83± 0.05 (41)
Summer	76.42 ^{bc} ± 0.02 (104)	76.03 ^a ± 0.01 (106)	69.65 ^{bB} ± 0.01 (89)	70.36 ^b ± 0.01 (75)	23.44 ^b ± 0.02 (89)	23.54± 0.03 (75)

SF, stall feeding; GS, grazing plus supplementation. Values in parenthesis indicates number of observations. Different superscripts (a, b and c) within the same column for same parameter are significantly different ($P < 0.01$). Different superscripts (A and B) within the same column for same parameter are significantly different ($P < 0.05$).

Angora bucks (20%) during the breeding season under Turkey conditions (Daskin *et al.* 2011).

The lower post-thaw semen quality of the bucks in this study in 2 rearing systems and 3 seasons could mostly be due to the consideration of only progressive motile sperms rather than total motile sperms subjectively apart from variation due to difference in processing methods, consideration of data transformation and retransformation etc. The non-significant variation of PTPM between rearing systems might be due the fact that the post-thaw recovery of semen is critically dependent on the semen processing in the laboratory apart from the initial semen quality rather than the nutrient intake of the bucks in different rearing systems. The loss of around 40–50% sperm progressive motility in the present study also indicated that the freezing and thawing rates need to be optimized either in the presently followed conventional freezing protocol or to adopt the automated semen freezer for higher post-thaw recovery.

In conclusion, the results indicated that the rearing systems did not significantly influence the post-thaw progressive motility of frozen buck semen; however, summer exerted significant effect on semen freezability of Jamunapari buck semen.

ACKNOWLEDGEMENT

Authors are thankful to the Director of this Institute for providing all necessary facilities to conduct this experiment. The sincere help rendered by Shri Dori Lal Gupta and Shri Hari Om, Technical Officers of this Institute is also thankfully acknowledged.

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